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HI-MILL MANUFACTURING COMPANY
FINAL TECHNICAL MEMORANDUM

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**HI-MILL MANUFACTURING COMPANY
FINAL TECHNICAL MEMORANDUM**

Revision #3
Master Copy

June 1991

Prepared for:

**Hi-Mill Manufacturing Company
1704 Highland Road
Highland, MI 48031**

Prepared by:

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FINAL TECHNICAL MEMORANDUM
HI-MILL MANUFACTURING COMPANY

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FINAL TECHNICAL MEMORANDUM EXECUTIVE SUMMARY

Geraghty & Miller, Inc. has been retained by the Hi-Mill Manufacturing Company (Hi-Mill) to complete the CERCLA Remedial Investigation/Feasibility Study (RI/FS) process which was initiated by the Techna Corporation (Techna) for Hi-Mill's Highland, Michigan, facility. The United States Environmental Protection Agency (USEPA) has requested Geraghty & Miller to provide a Draft Technical Memorandum commenting on the Draft RI and Baseline Risk Assessment reports previously submitted by Techna.

Geraghty & Miller was given three objectives for the review of these reports. The first objective was to comment on the interpretation of the data in the reports. The second objective was to evaluate the quality of the data in the reports. The third objective was to recommend any additional data collection necessary to complete the Remedial Investigation and Risk Assessment.

Memorandum Organization

This memorandum consists of this Executive Summary and seven separate sections, each pertaining to a distinct topic. These individual sections provide the background and detail for the conclusions presented in this summary. Part 1 contains a geologic/hydrologic review of the Draft RI report. Part 2 reports the results of an analytical data validation effort. A sampling program for the monitoring wells at the site is proposed in Part 3. Part 4 discusses the scope of a proposed ecological inventory/assessment at the site. Initial revisions to the Baseline Risk Assessment are proposed in Part 5. Part 6 is an assessment of additional work required to complete the Remedial Investigation and Risk Assessment. Part 7 contains a schedule for completion of the additional tasks.

Geology/Hydrogeology

Geraghty & Miller has reviewed the soil boring logs developed by Techna and found them adequate to identify three water-bearing zones at the Hi-Mill facility. The three zones are a shallow, perched water region; an intermediate aquifer; and a deep aquifer. These zones are identified in geologic cross sections developed by Geraghty & Miller from the Techna data.

Geraghty & Miller believes the static water-level measurements from the monitoring wells at the site provide most of the framework for determining the hydraulic gradients in the three water-bearing zones. Potentiometric surface maps have been developed by Geraghty & Miller from the Techna data.

One map shows the shallow, perched water moving east from the Hi-Mill building toward Target Pond. Some questions remain, however, concerning the hydraulic gradient slope direction northwest of the Hi-Mill building. Two additional shallow soil borings and monitoring wells are recommended in this area to better define the geology and hydrogeology in this area.

The intermediate aquifer map indicates a hydraulic gradient sloping to the west. Geraghty & Miller has also determined that wells SW-17, SW-18, and SW-19 are screened in the intermediate aquifer and that the intermediate aquifer could be experiencing recharge from Target Pond. Two additional intermediate monitoring wells located northwest of the Hi-Mill building are recommended in order to better define the geology and hydrogeology in the downgradient area of the Hi-Mill site.

The deeper aquifer map shows a southerly direction for the slope of the hydraulic gradient. Geraghty & Miller recommends that deep well DW-1 be replaced due to a formation collapse that occurred during its construction. This situation may have affected the data determining the direction and slope of the hydraulic gradient and also may have created a hydraulic connection between the intermediate and deep aquifers.

After reviewing the Techna data, Geraghty & Miller still perceives some uncertainty about the hydraulic relationship between Waterbury Lake and Target Pond. Some surface-water drainage patterns are similarly unclear. Difficulties with obtaining definitive surface-water levels from the staff gauges and the minimal number of monitoring points between the two water bodies precluded the drawing of conclusions. Geraghty & Miller recommends that the surface-water staff gauges be replaced and that two shallow piezometers be placed between Waterbury Lake and Target Pond to better define the surface-water hydrology.

Geraghty & Miller has reviewed the soil chemical data generated in the Remedial Investigation and has reached the following conclusions regarding the extent of contamination at the Hi-Mill site. Concentrations of a few metal compounds (aluminum, chromium, copper, nickel, and zinc) have been detected in the soils between the Hi-Mill building and Target Pond at levels elevated above the apparent background. These metal levels are probably either seepage residuals from the Hi-Mill process lagoons or are associated with fill material relocated during construction of the secondary process lagoon. Results from sediment samples also show two metal "hot spots" in Target Pond. These two areas are located in the northeast corner near the north Hi-Mill parking lot and on the east side across from the old Hi-Mill lagoons. Geraghty & Miller believes that additional information regarding volatile organic compound (VOC) levels in the Hi-Mill soils is required. Although the Techna data showed VOCs to be present in the soil near the former and current solvent tanks, large areas at the Hi-Mill facility were not analyzed for VOCs. A soil-gas survey is proposed to identify any additional "hot spots" for VOCs, correlate VOC presence with elevated metal levels, and guide placement of the proposed monitoring wells northwest of the Hi-Mill building.

A review of the ground-water chemical data by Geraghty & Miller has resulted in the following conclusions. Three VOCs (trichloroethene, 1,2-dichloroethene, and vinyl chloride) have been detected in the ground water at the Hi-Mill facility. These compounds were detected only in the shallow, perched water near the Hi-Mill building in SW-1, SW-3, SW-5, and SW-10. None of these analytes were detected in the intermediate or deep aquifers. Geraghty & Miller recommends that a limited set of ground-water samples, collected from monitoring wells near the Hi-Mill building, be analyzed for VOCs as specified in the proposed sampling plan in Part 3.

Metals data from ground-water samples collected to date are less informative than the VOC data. Small numbers of samples and complex statistical requirements for determining levels present that are significantly above background levels make conclusions regarding elevated metals levels in ground water premature at this time. Geraghty & Miller recommends that short list metals be analyzed in samples from a majority of the monitoring wells at the facility to increase the size of the database for decision-making. Some of the upgradient

intermediate and some of the deep monitoring wells are not deemed necessary for additional metals ground-water sampling. Specifics of the proposed sampling plan are included in Part 3.

Laboratory Data Validation

A Geraghty & Miller data quality assurance manager reviewed the analytical laboratory data for compliance with the data quality objectives of the Techna RI work plan. The data evaluation was performed at a near-Contract Laboratory Program (CLP) level because either raw data for the analyses were not always available or there was not sufficient time available to review all of it. Data were categorized as either quantitative, qualitative, or unusable. Quantitative data have accurate absolute values. Qualitative data are only useful for relative comparison purposes. Unusable data are self-explanatory.

Most of the analytical laboratory data have been categorized as quantitative or qualitative; less than 1 percent is unusable. Geraghty & Miller estimates that approximately 90 percent of the ground-water and surface-water data are quantitative; the remaining 10 percent are qualitative. Approximately 75 percent of the soil and sediment data are quantitative; the remaining 25 percent are qualitative. Given this evaluation of the analytical data, Geraghty & Miller is confident that its interpretation of the extent of contamination is founded on a reliable database.

Monitoring Well Sampling

Geraghty & Miller recommends that a second round of monitoring-well samples be collected at the Hi-Mill facility. These additional samples would be used to confirm results of the first sampling round and to provide additional data for defining the extent of ground-water contamination. Some of the wells sampled in the first round are not recommended for resampling, as previously explained; however, there are samples recommended for the newly installed wells. The second round of samples should be analyzed for field parameters (pH, temperature, and specific conductance), a short list of metals, and VOCs. Not all of the sampled wells should have analyses for VOCs. Details of wells to be sampled and parameters to be analyzed are presented in Part 3.

Ecological Inventory/Assessment & Risk Assessment

Geraghty & Miller believes that an Ecological Inventory/Assessment should be conducted for the Hi-Mill site and the results used for the Risk Assessment. Existing ecological information concerning the Hi-Mill site is considered to be inadequate for use in a CERCLA Risk Assessment.

A three phase program is proposed. The first phase is the collection of sediment samples for bioassays from the metals' "hot spots" in Target Pond. The sediment bioassay results will be used as measures of toxicity in areas of elevated metals. The bioassays will be used as "surrogates" for additional sediment and surface-water chemical results because they reflect better the complex effects of exposure to multiple toxic compounds at varying concentrations. If the Risk Assessment identifies significant levels of risk associated with exposure to the sediment, additional sediment and surface-water sampling may be required during the initial stages of the Feasibility Study.

The second phase is a literature review in preparation for a possible third phase comprising additional field work. The work plan and scope of the field work will be dependent on the results of the bioassays and literature review. The results of field work in Phase III may require an RI addendum to be prepared.

Geraghty & Miller has been requested by Hi-Mill to proceed with revisions to the Draft Baseline Risk Assessment submitted by Techna to assist the USEPA in its preparation of the Risk Assessment. Part 5 of the memorandum describes the proposed revisions, presents a site conceptual model, and lists exposure dose equations for exposure pathways.

Data Sufficiency Assessment & Schedule of Deliverables

Part 6 of the memorandum summarizes recommendations of Geraghty & Miller for additional data collection at the Hi-Mill site. Part 7 of the memorandum presents a schedule

for completing the recommended additional work. The revised Draft Remedial Investigation is proposed for completion on April 1, 1991. The Ecological Inventory/Assessment and RI Addendum are scheduled for completion on June 1, 1991.

Respectfully submitted,

GERAGHTY & MILLER, INC.

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PART 1: GEOLOGIC/HYDROGEOLOGIC REVIEW

**FINAL TECHNICAL MEMORANDUM
HI-MILL MANUFACTURING
HIGHLAND, MICHIGAN**

June 1991

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PART 1: GEOLOGIC/HYDROGEOLOGIC REVIEW

GEOLOGY

The Hi-Mill Manufacturing (Hi-Mill) site is located at 1704 Highland Road (Highway M-59), in Highland, Michigan. The site is situated in the North 1/2 of Section 23, T2N, R7E, Highland Township, Oakland County, Michigan (Figure 1). The site (Figure 2) occupies a 4.5 acre irregularly-shaped parcel surrounded by state property. The average elevation of the parcel is approximately 1010 feet (ft) above mean sea level (msl).

An expedited background search was conducted to obtain materials related to the geology of the Hi-Mill facility. The materials referenced include the Soil Survey of Oakland County, Michigan, (1980); the Surficial Geology of Oakland County, Michigan, (1980); the Bedrock Geology Map of Oakland County, (1980); and the boring logs generated by Techna Corporation during their remedial investigation (RI) activities at the Hi-Mill site.

The Oakland County soil survey report revealed that the study area consisted of two soil types. The soil located south and east of M-59 was classified in the Oshtemo-Spinks-Houghton association, and the soil located north and west of M-59 was classified in the Urban land-Spinks-Oshtemo associations (Figure 3). Both are categorized as well-drained, sandy soils on outwash plains, beach ridges, and moraines. The Oshtemo-Spinks-Houghton soil can also include poorly-drained, mucky soils formed in bogs.

According to the surficial geology map of Oakland County (Figure 4), the entire site is located on an outwash plain. Typical materials represented in this fluvioglacial environment consist of relatively well-stratified deposits of well-sorted sands, silts, and clays. Deposition of these materials occurred in a proglacial environment beyond the terminal edge of the ice. The sands are typically deposited by moving stream channels; the finer silts and clays are deposited in calmer, lacustrine environments. The combined thickness of the unconsolidated glacial deposits in the area range between 300 and 320 ft.

The bedrock formation underlying the unconsolidated glacial material is the Coldwater Shale. The shale was deposited during the early Mississippian Period and rests approximately 700 ft above msl. Figure 5 shows the slope of the bedrock surface to be due south.

Interpretive cross sections of the stratigraphy underlying the site were drafted by Geraghty & Miller from boring logs compiled by Techna. Techna directed the installation of the 28 monitoring wells presently located at the site (Figure 7). The logs from each of the monitoring wells and from soil borings (Figure 6) were used to construct the cross sections.

The stratigraphic profile shown in the cross sections includes the following seven distinct hydrogeologic units: I, shallow soils and granular material; II, brown periglacial and/or post-glacial lacustrine deposits; III, blue periglacial and/or post-glacial lacustrine deposits; IV, glacial outwash deposits; V, interglacial lacustrine deposits; VI, glacial outwash deposits; and VII, post-glacial fluvioglacial outwash.

The uppermost unit in the profile is Hydrogeologic Unit I, a thin veneer of sandy topsoil that overlies a thin horizon of fine sands, silts and other various soil compositions. Properties of this profile are outlined in the Oakland County Soil Survey. This 1- to 5-ft thick horizon is perched on a stiff, brown, variegated clay that is Hydrogeologic Unit II.

Unit II appears to be quite uniform in thickness across the study area. Although saturated sand and silt seams were detected in the brown clay, its low permeability is acting as a barrier against vertical migration. Figures 8 and 9 show the east-west cross section A - A'. The cross section shows the saturated, sandy overburden and the water contained in the Target Pond to be perched on this clay unit.

The brown, variegated clay grades into a stiff blue/gray clay (Hydrogeologic Unit III) with depth. The cross sections show that this contact occurs at an approximate elevation of 998 ft above msl. The thickness of the blue/gray clay unit varies over of the study area. As shown in the east-west cross section A - A' and in the north-south cross section B - B' (Figure 10), the clay unit thins to the east and south. If the contact line between the blue clay and the underlying outwash sands was projected past our data points, the clay unit would likely pinch

out completely south of Waterbury Lake and east of monitoring well SW-19. Figure 11 shows the spatial orientation of (the fence diagram) C - C' (Figure 12). The fence diagram shows that the blue clay is absent from the area surrounding monitoring well SW-18.

The saturated outwash sands of Hydrologic Unit IV underlie the blue clay of Hydrogeologic Unit III. The sands contain the intermediate flow system. The confined aquifer is most likely recharged from locations east and south of the site where the outwash sands are exposed to the ground surface or recharging streams and lakes.

Hydrogeologic Unit V forms the base of the intermediate aquifer and is composed of interglacial blue clay similar to that of Hydrogeologic Unit III. It also forms the confining cap to the deep aquifer.

A second horizon of outwash sands comprise Hydrogeologic Unit VI. This unit was deposited in the same type of environment as Hydrogeologic Unit IV. Although Unit VI is not as thick as Unit IV, its saturated sands contain and produce water of sufficient quantity and quality to be classified as an aquifer.

The maximum depths associated with the deep borings installed at the site prohibited the correlation of any additional stratigraphy below the outwash sands of Hydrogeologic Unit VI. However, it should be noted that west of the site near monitoring well SW-2 alternating deposits of sand and silt (Hydrogeologic Unit VII) replaced the variegated, brown clay and have cut into the existing blue clay of Hydrogeologic Unit III. This alternating depositional sequence is indicative of a calm, lacustrine environment where the stratified sand and silt were probably deposited in a higher-energy, fluvial environment. The contact elevations and locations of hydrogeologic Unit VII are crucial in determining ground-water flow directions northwest of the Hi-Mill facility.

SURFACE WATER HYDROLOGY

Two surface-water bodies are present within the study area. These include Waterbury Lake, located south of the site; and the Target Pond, located east and northeast of the Hi-Mill facility. Based on information obtained from aerial photographs and topographic maps of the area, the natural drainage for both surface-water bodies is to the north across M-59. To confirm this hypothesis, Techna installed staff gauges in both water bodies to monitor surface-water elevations. Staff gauges were placed in the Target Pond (SG-1 and SG-2), Waterbury Lake (SG-3), the north arm of Waterbury Lake (SG-4), in standing water north of the north arm across M-59 (SG-5), and in standing water north of the Target Pond across M-59 (SG-6). Locations for the six staff gauges are shown in Figure 7.

Staff gauge readings for the Waterbury Lake area indicate that the three staff gauges (SG-3, SG-4, and SG-5) monitor three distinct water bodies. However, a review of aerial photographs and field observations made during a Geraghty & Miller site visit suggest otherwise. Drainage trenches extending north toward M-59 were constructed in Waterbury Lake sometime prior to 1949. The north arm was also constructed in 1959 during filling operations from activities associated with the adjacent airport. During the site visit, water drained from the north arm of Waterbury Lake through a culvert under M-59 to the ponded water north of the highway. This outlet is only used during periods of high water. During periods of low water, Waterbury Lake is an isolated surface-water body.

The water elevations collected from Target Pond staff gauges and the surrounding monitoring wells indicate that the ground-water gradient is toward the pond. The 6/8/90 potentiometric surface map of the shallow ground water forms a radial pattern draining toward the pond. This radial configuration suggests that the pond is a discharge area isolated from the surrounding watershed except during periods of high water.

The hydraulic connection between the two surface-water bodies is not presently known. Although they are not connected surficially, they may be connected through ground-water flow during periods of high water. The 6/8/90 potentiometric surface map suggests two possible

contour patterns for the area between the two bodies. Figure 13 shows a contour configuration that suggests ground-water flow from the 1004 ft elevation in the pond to the 999.57 ft elevation in Waterbury Lake. Figure 14 suggests that a ground-water divide is present between the two bodies. Water infiltrating the area north of the 1007 ft contour would, therefore, recharge the Target Pond, and water infiltrating south of the 1007 ft contour would recharge Waterbury Lake. The installation of additional piezometers would be required to determine which scenario is correct. The installation of piezometers in that area would also determine if the high, static water elevations measured in monitoring wells SW-12 and SW-15 are representative. Although the high values observed in those wells are questionable, they were still utilized in the construction of the 6/8/90 potentiometric surface map.

HYDROGEOLOGY

On October 31 and November 1, 1990, a complete round of static water-level elevations were collected from 27 wells, six (6) piezometers, and six (6) staff gauges located at the Hi-Mill facility. The static water levels were used to draft potentiometric surface maps of the study area. These contour maps show three (3) distinct ground-water flow systems underlying the site. The three flow regimes include a shallow, perched system; an intermediate flow system; and a deep flow system. Static water-level elevations for individual wells and other pertinent ground-water monitoring well information are presented in Table 1.

The potentiometric surface map for the perched, ground-water flow system was constructed by using wells that were set within or above the first clay unit encountered in the boreholes. This low permeability horizon was typically described as a stiff, brown, variegated, silty clay. The data set included shallow monitoring wells SW-1, SW-3, SW-4A, SW-5, SW-6B, SW-7, SW-8, SW-9A, SW-10, SW-11, SW-14, existing piezometers (wells) EW-1, EW-2, EW-3, EW-4, EW-5, EW-6, and staff gauges SG-1, SG-2, SG-3, SG-4, SG-5, and SG-6. However, the elevations collected from the staff gauges did not correlate well with the previous measurements and were, therefore, omitted from the shallow potentiometric map. The potentiometric surface map for the perched ground water is shown in Figure 15.

The static water-level elevations recorded for shallow monitoring wells SW-2, SW-12, SW-15, SW-17, SW-18, SW-19 were not utilized in preparing the potentiometric surface map for the shallow flow system. Monitoring well SW-2 was eliminated from Figure 15 because it was screened below the brown clay (see Figure 9) identified at the site. According to the Techna boring logs, the well is screened in a saturated sand seam 23 to 29 ft below land surface (bls). The log described an alternating depositional sequence of sand (1 to 6 ft), clay (6 to 10 ft), sand (10 to 18 ft), silt (18 to 23 ft), sand (23 to 29 ft) and clay (29 to 32 ft). At this time the interval screened by SW-2 cannot be correlated with any of the three presently delineated flow systems. Static water levels for SW-2 have, therefore, been omitted from all potentiometric surface figures.

Ground-water elevations from monitoring wells SW-12 and SW-15 have been removed from Figure 15 due to anomalously high static water levels (1008.85 and 1006.25 ft above msl respectively). According to boring logs and slug test results the well screens in both wells are set in materials of low permeability. It is presently believed the saturated sand horizon detected 1 ft below grade is recharging the well faster than the low permeable materials can transmit it. The well casing fills to an elevation that corresponds to the saturated sand seam and creates the anomalously high static elevation.

Ground-water elevations from monitoring wells SW-17, SW-18, and SW-19 were also omitted from Figure 15. Each of these wells have their screen set below the brown, variegated clay. In monitoring well SW-17, 27 ft of clay was encountered before setting a screen in a sand horizon 39 ft bls. In monitoring well SW-18 the thinning, confining clay unit was penetrated and the well screen was set in a saturated sand unit below it. In monitoring well SW-19, a silty clay layer and a clayey silt layer combined to form a low permeability horizon extending from 3 to 21 ft bls. A saturated sand unit was then encountered between 21 ft and the end of the boring (37 ft). The screen of SW-19 is set at 30 ft bls in this saturated sand unit. In each of these three borings the well screens were set in materials which correspond to the intermediate flow system. Therefore, static water-level elevations from monitoring wells SW-19, SW-18, and SW-17 are not included in the potentiometric surface map of the shallow wells but do appear in the potentiometric surface map for the intermediate wells.

The well screens of these six monitoring wells mentioned above (SW-2, SW-12, SW-15, SW-17, SW-18, and SW-19) were not set within or above the first clay unit. Ground-water elevations were, therefore, eliminated from Figure 15.

Shallow ground-water elevations ranged from a high of 1007.57 ft above msl in monitoring well SW-21 to a low elevation of 1000.23 ft above msl measured in monitoring well SW-11. The staff gauges elevations of the surrounding surface-water bodies are also represented in the potentiometric map of the perched system to show how they relate to the shallow ground water. The potentiometric surface map for the perched water (Figure 15) indicates that shallow ground water flows radially from the site with preferential flow towards the east/northeast and possibly to the west/southwest.

The general radial flow of the perched ground water from the site is caused by the local topography and artificial recharge. Plate I shows a topographic map of the site produced for the Draft RI report, (Techna, 1990). The 2 ft contour interval on the map shows that the majority of the site is situated at an approximate elevation of 109 ft above msl. With the exception of the 128 ft elevation directly north of the site, the grounds encompassing the site are lower in elevation. The local topographic high acts as a natural recharge point to the lower elevations that surround it. The radial flow in the area is also influenced by the waters discharged through the facility's septic field and drain spouts. The artificial recharge from the facility compounds the natural recharge and forms a local potentiometric high (1007 ft above msl).

The preferential northeast flow direction observed in Figure 15 is in agreement with the general topographic gradient of the site (Figure 1) and is consistent with the slope of clay lense surface (Figure 17) delineated by Techna in the Draft RI report. With the exception of the two topographic lows associated with the former process wastewater lagoons, the clay layer slopes to the northeast and to the west. Similar contour configurations found in other maps of analytical data collected from the site also support a preferential flow direction to the northeast.

A preferred western flow direction may also be plausible. Figure 15 shows a southwest flow direction based on a limited number of monitoring wells and staff gauges in that area. A western flow direction is also supported by the slope of the local topography, the slope of the clay lens, and the grade of M-59. As seen in Plate I, the topography west of the plant slopes toward the north arm of Waterbury Lake. The clay-soil interface appears to slope to the east and northwest. The construction materials of M-59 may have created a preferential pathway to the southwest. However, limited information on the north and west side of the plant make it impossible to determine ground-water flow in that area.

Based on the appearance of two potential preferential flow directions, the site could be located on a shallow ground-water divide. Based on the topographic map and the clay lens surface map, the potential for a second preferential ground-water flow direction exists within the perched system. Both maps indicate that a preferential southwest flow is possible. However, inadequate well coverage west and northwest of the Hi-Mill facility prevent any conclusions from being drawn.

The potentiometric surface contours of the intermediate wells show the ground water to be flowing to the west (Figure 18). This flow direction is consistent with the one reported by Techna in their Draft RI report. Figure 13 was constructed from static water-level elevations collected from monitoring wells IW-1, IW-2, IW-3, IW-4, IW-5, SW-17, SW-18, and SW-19. Geologic cross sections confirm similar monitoring elevations of all the wells included in this figure. Static elevations measured in the intermediate wells ranged from 1002.66 (SW-19) to 995.78 ft (IW-1) above msl. The difference in elevation between the two wells was observed over a distance of 2,100 ft, creating a calculated gradient of 0.003 ft/ft. The intermediate aquifer is most likely recharged from the morainic system to the east and possibly from Waterbury Lake to the southeast.

Ground-water flow in the deep aquifer is to the southeast (Figure 19). This flow direction is consistent with the direction identified by Techna and is in agreement with the southern slope of the bedrock surface. The flow direction is based on the data from three wells (DW-1, DW-2, and DW-3), the construction of one of which is questionable. Monitoring well DW-1 is surrounded by 50.5 ft of natural sand formation collapse. This construction technique

is sound. However, the borehole penetrated the confining clay (2 to 4 ft) unit between the intermediate and deep aquifers, and, therefore, should have been plugged. The present well construction method could affect the potentiometric elevation recorded for DW-1 and, therefore, influence the calculated flow direction for the deep aquifer. Otherwise, the present well construction is not expected to change the interpretations of this report.

In summary, three distinct flow systems exist at the site: a shallow perched system, an intermediate system, and a deep flow system. The shallow, perched system does not transmit or produce sufficient volumes of water to be classified as an aquifer. Both the intermediate and deep flow systems are classified as producing aquifers.

Each ground-water system flows in a different direction. The ground-water flow of the shallow, perched system is in a radial direction from the Hi-Mill facility with a preferential eastern flow toward the Target Pond. A potential and preferential west to southwest ground-water flow may exist at the facility. Additional field work will have to be performed on the west side of the plant to collect the data necessary in completing the definition of the shallow flow system.

The flow direction in the intermediate aquifer system is due west. The potentiometric surface map for the intermediate aquifer contains data from three monitoring wells (SW-17, SW-18, SW-19) that were misidentified by Techna. East of the facility, the dimensions of the intermediate aquifer are well defined. However, geologic cross sections composed from the boring logs indicate a completely different depositional environment to the west. Additional field work is needed to determine how the gradational changes and formational contacts on the west side of the facility will affect the intermediate flow system.

The flow direction in the deep aquifer system is to the southeast. The potentiometric surface map of the deep aquifer correlates fairly well with the slope of the bedrock surface in the area. A slightly different flow direction may be observed if monitoring well DW-1 had been constructed properly.

EXTENT OF CONTAMINATION

The existing site conditions at the Hi-Mill facility were determined by Techna during their RI activities. Their investigation included a soil boring program, installation of monitoring wells, and the collection of water and sediment samples from the Target Pond and Waterbury Lake.

Soil, ground-water, surface-water, and surface-water-sediment samples from the study area were collected and analyzed by certified laboratories. Each sample matrix was analyzed for a different suite of parameters. Table 2A summarizes the soil analyses, Table 2B, 2C and 2D summarize the ground-water, surface-water, and surface-water-sediment analyses. Table 2E lists and identifies the chemical compounds in each analysis.

The initial field work began with the collection of eight (8) background soil samples from six different locations. The background soil samples were analyzed for short list metals (aluminum (Al), chromium (Cr), copper (Cu), nickel (Ni), silver (Ag), and zinc (Zn)) and other inorganic parameters listed in Table 2E. Concentrations from the eight (8) background samples were averaged to smooth individual factors (ie. topography, biota, vegetation, parent material) that dominate particular soil-forming environments (Figure 20). However, the laboratory results of three (3) of the ten (10) samples contained metal concentrations at levels which skewed the background averages. Therefore, both samples from background sample BG-2 and one from BG-4 were eliminated from the statistical analysis presented in Table 3. The average metals concentrations contained in the background soil concentrations were then used to evaluate the distribution of the metals found in the soils surrounding the plant.

The soil investigation program for the Hi-Mill facility was designed to evaluate potential metals contamination in the surface and subsurface soils surrounding the plant. Sample grids were constructed on the east, north, and south sides of the plant. A 60 ft by 60 ft grid was established east of the facility to determine the potential metals contamination from the former lagoons and the aerated lagoon waters. Soil samples were collected at various intervals from grid intersection points and analyzed for short list metals (SLM). The SLM

concentrations that were above averaged background concentrations were plotted as a function of depth. Figures 21-24 show contoured concentrations of chromium from 0 to 1 ft bls, 1 to 3 ft bls, 3 to 8 ft bls, and 8 to 16 ft bls. The isoconcentration map identifies several areas of high chromium concentrations at each depth. With the exception of the 1620 ug/kg concentration detected 5.5 ft bls, the map also reveals a decrease in chromium with depth. A similar figure was produced for the copper concentrations. Figures 25-28 show elevated copper concentrations in locations similar to those of chromium. Review of other SLM indicates the same general trends. It appears there are several source areas that can be identified by the grid locations. Therefore, the SLM isoconcentration maps generated for soil samples collected over the 60 ft by 60 ft grid appears to be sufficient in quantity and quality to determine the potential extent of metals contamination. Figures 29-32 show the total number of soil samples collected at each interval.

Soil sampling was also performed on the north and south sides of the plant to investigate the areas surrounding the abandoned water supply wells. Soil samples were collected over two 20 ft x 40 ft grids and analyzed for volatile organic compounds (VOCs - USEPA Method 8240) and SLM. The only significant volatile compounds detected in the two areas were chlorobenzene, 1,2-dichloroethene, 1,1,1-trichloroethane, trichloroethene, and xylene. Due to the horizontal and vertical distribution of these constituents, a soil-gas survey is recommended. The survey would consist of collecting soil and water samples from the areas surrounding the former TCE tank locations and east and west of the plant to determine the extent of volatile contamination. If "hot spots" of the contaminants of concern are identified, additional borings may be required. The survey can also be combined with the installation of ground-water piezometers to determine the ideal locations for installing the additional ground-water monitoring wells on the north side of the Hi-Mill facility.

Ground-water monitoring wells were sampled in accordance with the analytical summary provided in Table 2B. All shallow, intermediate, and deep wells were sampled for the SLM. Twenty-one (21) of the twenty-eight (28) wells (SW-1, SW-2, SW-3, SW-4, SW-5, SW-6, SW-8, SW-9A, SW-10, SW-11, SW-12, SW-20, SW-22, IW-1, IW-2, IW-3, IW-4, IW-5, DW-1, DW-2, and DW-3) were tested for VOCs. Seven inorganic analyses were performed on samples collected from SW-2, SW-5, SW-8, SW-22, IW-1, IW-3, and IW-5. Four wells (SW-2, SW-5, SW-8, and IW-1) were

selected for a polynuclear aromatics (semi-volatiles) analysis and all twenty (20) shallow wells were analyzed for ammonia and total nitrogen.

Ground-water analytical results for the short list metals indicated that six monitoring wells (SW-7, SW-10, SW-11, SW-17, SW-19, and SW-20) contained metals concentrations above detection limits. No SLM were detected in any of the monitoring wells classified as "IW" or "DW". Monitoring wells SW-7 and SW-10 contained 93.3 and 33.8 micro grams per liter (ug/l) of copper. Due to this location, these concentrations may be attributed to former discharges associated with the lagoon. However, both concentrations are below drinking water standards. Any remedial actions will be based on the ecological impact determined in the ecological assessment.

Monitoring well SW-7 also contained 22.2 ug/l of zinc. This concentration is also below MDNR drinking water standards of 5 milligrams per liter (mg/l).

Elevated levels of chromium (45.8 ug/l) and nickel (149 ug/l) were detected in SW-15. The metal concentrations exceed those outlined in the USGS Open File Report: Chemical and Physical Characteristics of Natural Ground Waters in Michigan.

Monitoring well SW-19 is an upgradient intermediate well located approximately 2,000 feet west of the site. The high nickel concentration (119 ug/l) is atypical of outwash material. However, due to the proximity of the well, the unlikely vertical migration pathway from the site and the fact that nickel was never used at the plant makes Hi-Mill an unlikely source.

Monitoring well SW-20 contained elevated levels of aluminum (648 ug/l), nickel (131 ug/l) and zinc (22.1 ug/l). Based on the 6/8/90 potentiometric surface map elevations, the shallow ground-water flow in the area of SW-20 is toward the Target Pond. The well is also downgradient of two wastewater discharge beds owned by Numatics. The source of the metals contamination in SW-20 is, therefore, somewhere to the northeast in the general direction of the Numatics plant.

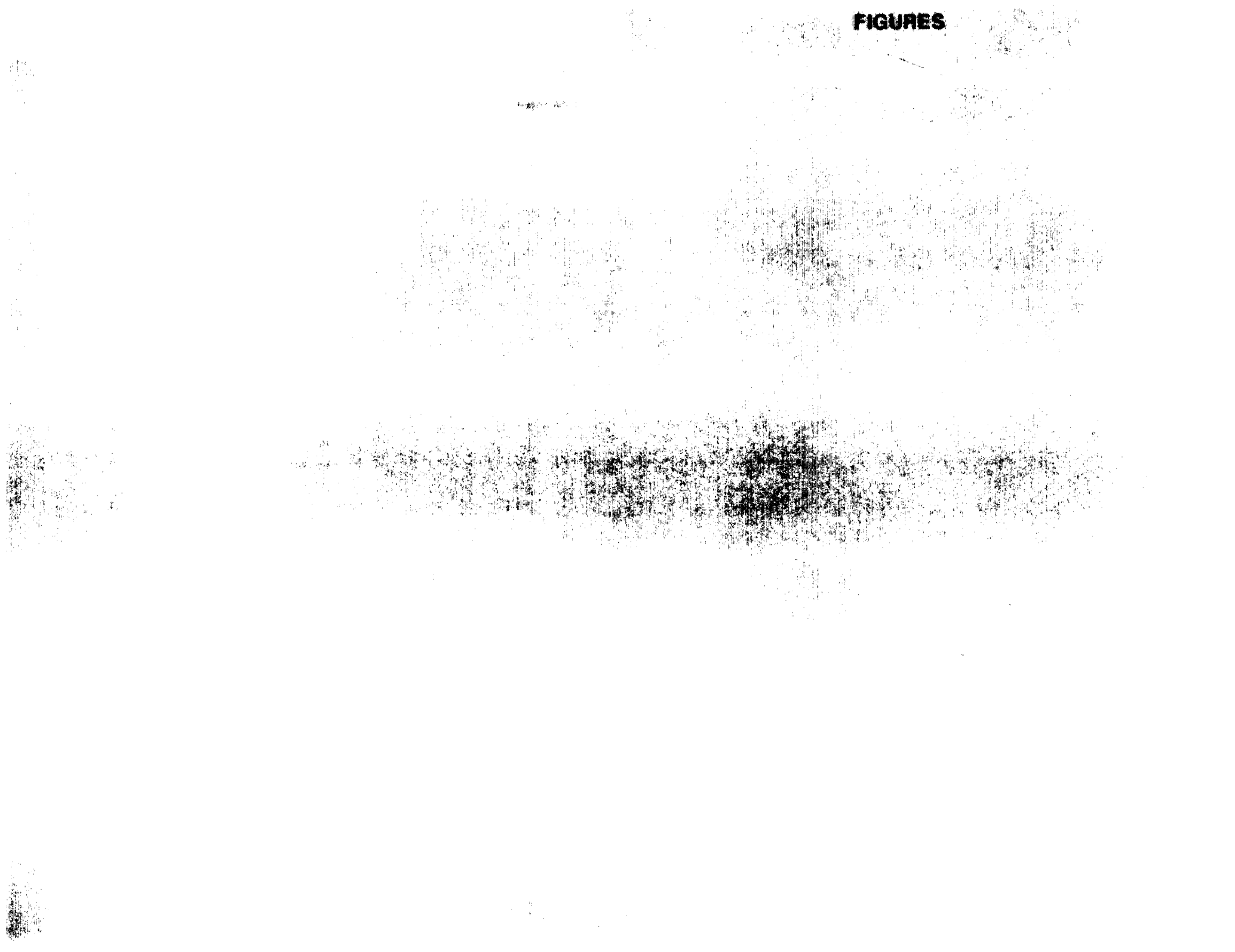
Due to the minor concentrations of metals in the limited number (six) of monitoring wells, Geraghty & Miller proposes that the Approved Techna Sampling Plan be modified according to Part 3 of the memorandum. Only three monitoring wells (SW-7, SW-10, SW-11) adjacent to the Hi-Mill facility contained metals concentrations above detection limits, and the levels that were detected were below drinking water standards. The remaining three wells that exhibited metal concentrations were located in areas where a source (natural or manmade) other than Hi-Mill may be responsible. It is, therefore, recommended that the SLM analysis for monitoring wells SW-19, SW-18, SW-17, SW-15, and SW-12 be eliminated from the sampling plan. This proposal is suggested not to reduce the data collected but rather to focus and refine it around the potential source. The SLM and VOC analyses on the additional wells installed on the north/northwest side of the facility will promote a better understanding of the potential impact caused from former plant operations.

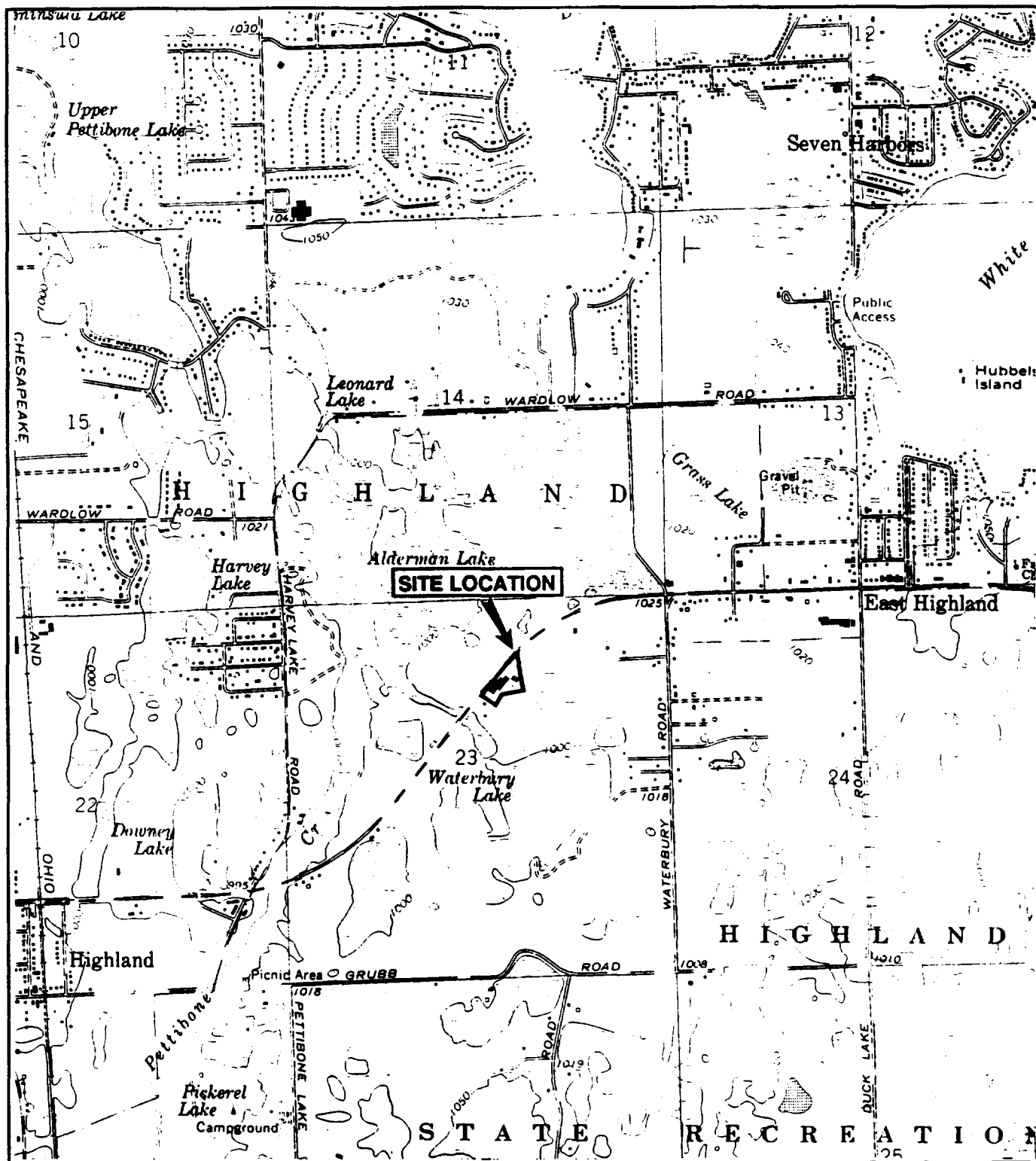
The only significant VOCs detected in the ground water were trichloroethene (TCE), 1,2-dichloroethene (DCE), and vinyl chloride. All other VOCs detected in the ground water were attributed to laboratory contamination (See Part 2, Analytical Laboratory Data Validation). Trichloroethene was detected in two monitoring wells, SW-1 and SW-3. Water from monitoring well SW-1 contained 1.1 mg/l of TCE and water from monitoring well SW-3 contained 0.14 mg/l of TCE. Dichloroethene, a biodegradation product of TCE, was detected in four monitoring wells: SW-1, SW-3, SW-5, and SW-10. Dichloroethane concentrations ranged from 0.36 mg/l in SW-1 to 0.03 mg/l in SW-10. Vinyl chloride is also a byproduct of TCE and was detected in SW-1, SW-3, and SW-5. However, the vinyl chloride concentrations listed in the laboratory reports were below quantitative detection limits. Figure 33 shows concentrations of TCE and DCE in the monitoring wells that had water samples submitted for VOC analysis. Based on the distribution of the TCE/DCE concentrations observed in Figure 33, there appear to be two separate source areas - one on the north end of the plant near SW-3, and one on the south side near SW-1. Historic information on the facility indicate that TCE had been stored in both locations in the past.

Surface water and surface-water sediment are discussed in Part 4: Ecological Inventory/Assessment.

FIGURES

Figure 1





SOURCE: USGS 7.5 Minute Topographic Map, HIGHLAND, MICHIGAN Quadrangle, 1983

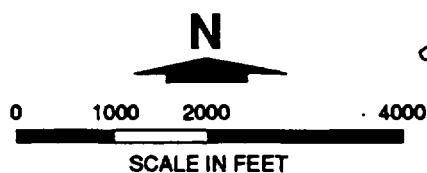
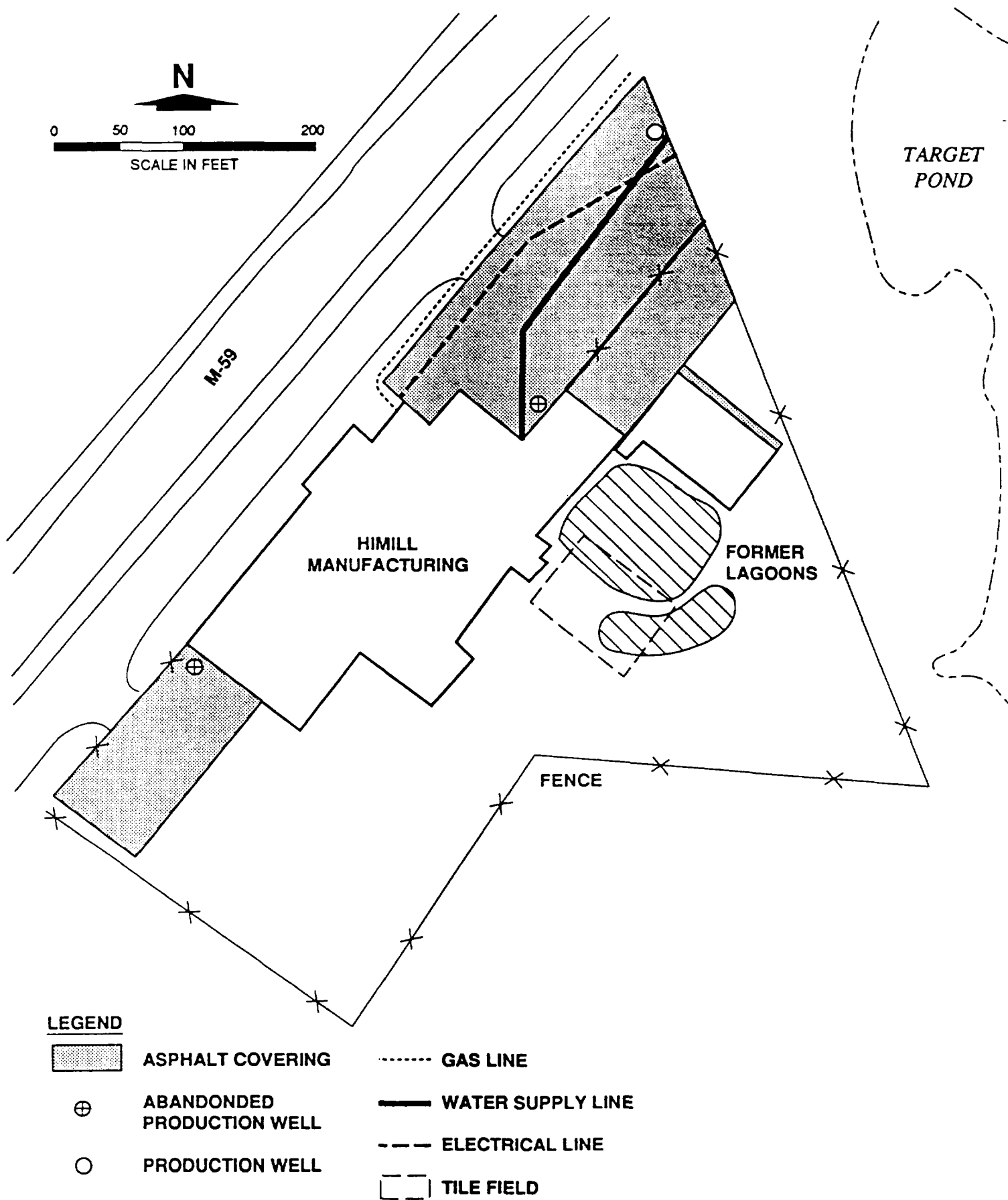


FIGURE 1
SITE LOCATION
HI MILL MANUFACTURING
HIGHLAND, MICHIGAN



LEGEND



ASPHALT COVERING



**ABANDONED
PRODUCTION WELL**



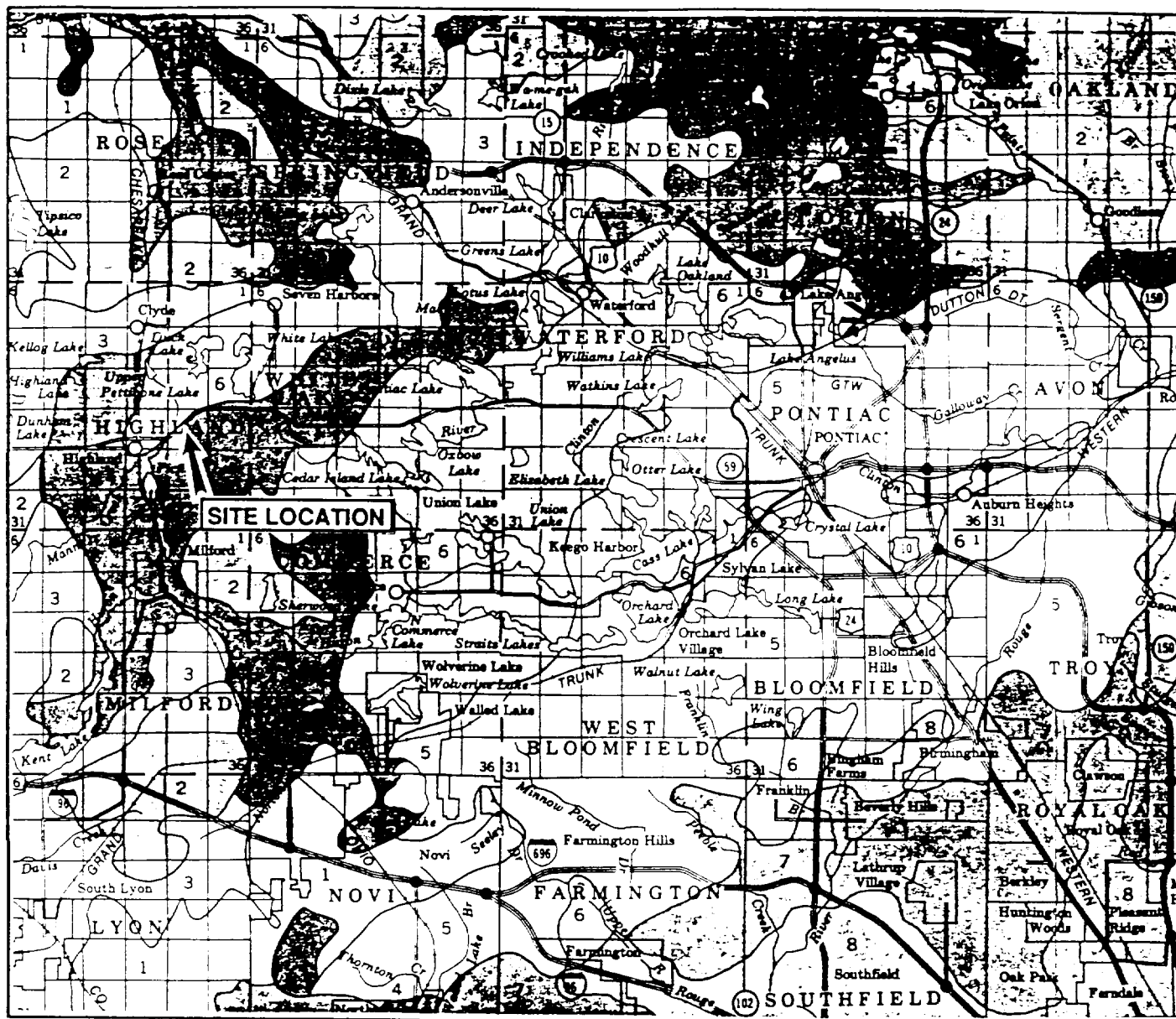
PRODUCTION WELL

..... GAS LINE

—— WATER SUPPLY LINE

- - - ELECTRICAL LINE

[] TILE FIELD



SOURCE: U.S. Department of Agriculture Soil Conservation Service Soil Survey of Oakland Co. 1980

SOIL LEGEND*










- | | |
|---|---|
| 1 | Marlette-Capac-Houghton: Nearly level to hilly, well drained to very poorly drained loamy and mucky soils, on till plains and moraines and in bogs |
| 2 | Riddles-Marlette-Houghton: Nearly level to steep, well drained, moderately well drained, and very poorly drained loamy and mucky soils, on moraines and till plains and in bogs |
| 3 | Fox-Oshtemo-Houghton: Nearly level to hilly, well drained and very poorly drained loamy sand, and mucky soils, on outwash plains, moraines, and beach ridges and in bogs |
| 4 | Oshtemo-Spinks-Houghton: Nearly level to steep, well drained and very poorly drained sandy and mucky soils, on outwash plains, beach ridges, and moraines and in bogs |
| 5 | Urban land-Marlette-Capac: Urban land and nearly level to hilly, well drained to somewhat poorly drained loamy soils, on till plains and moraines |
| 6 | Urban land-Spinks-Oshtemo: Urban land and nearly level to rolling, well drained sandy soils, on outwash plains, beach ridges, and moraines |
| 7 | Urban land-Blount-Lenawee: Urban land and nearly level and gently undulating, somewhat poorly drained and poorly drained loamy and silty soils, on lake plains and moraines |
| 8 | Urban land-Thetford: Urban land and nearly level, somewhat poorly drained sandy soils, on lake plains and outwash plains |

*Texture terms refer to the surface layer of the major soils in the map units



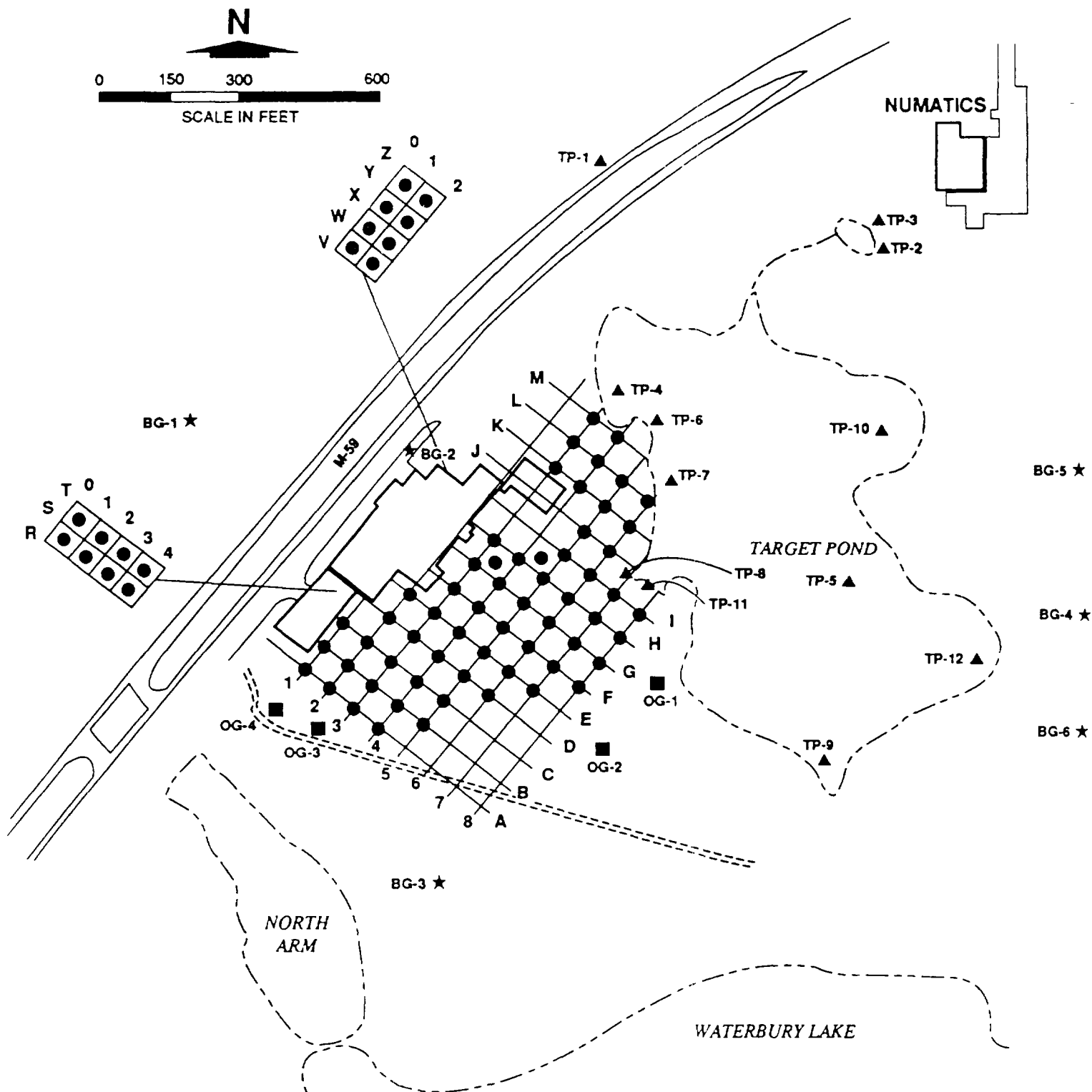
SOURCE: Oakland Co. Planning Commission, Surficial Geology of Oakland Co., 1980

LEGEND

	MORaine
	OUTWASH PLAIN
	TILL PLAIN
	KAME
	SANDY LAKEBED OR DRAINAGE CHANNEL
	CLAY LAKEBED OR PONDED WATER
	WATERLAID MORaine
	GLACIAL LAKE BEACHES
	LAKE



SOURCE: Oakland Co. Planning Commission Bedrock Geology of Oakland Co. 1980



LEGEND

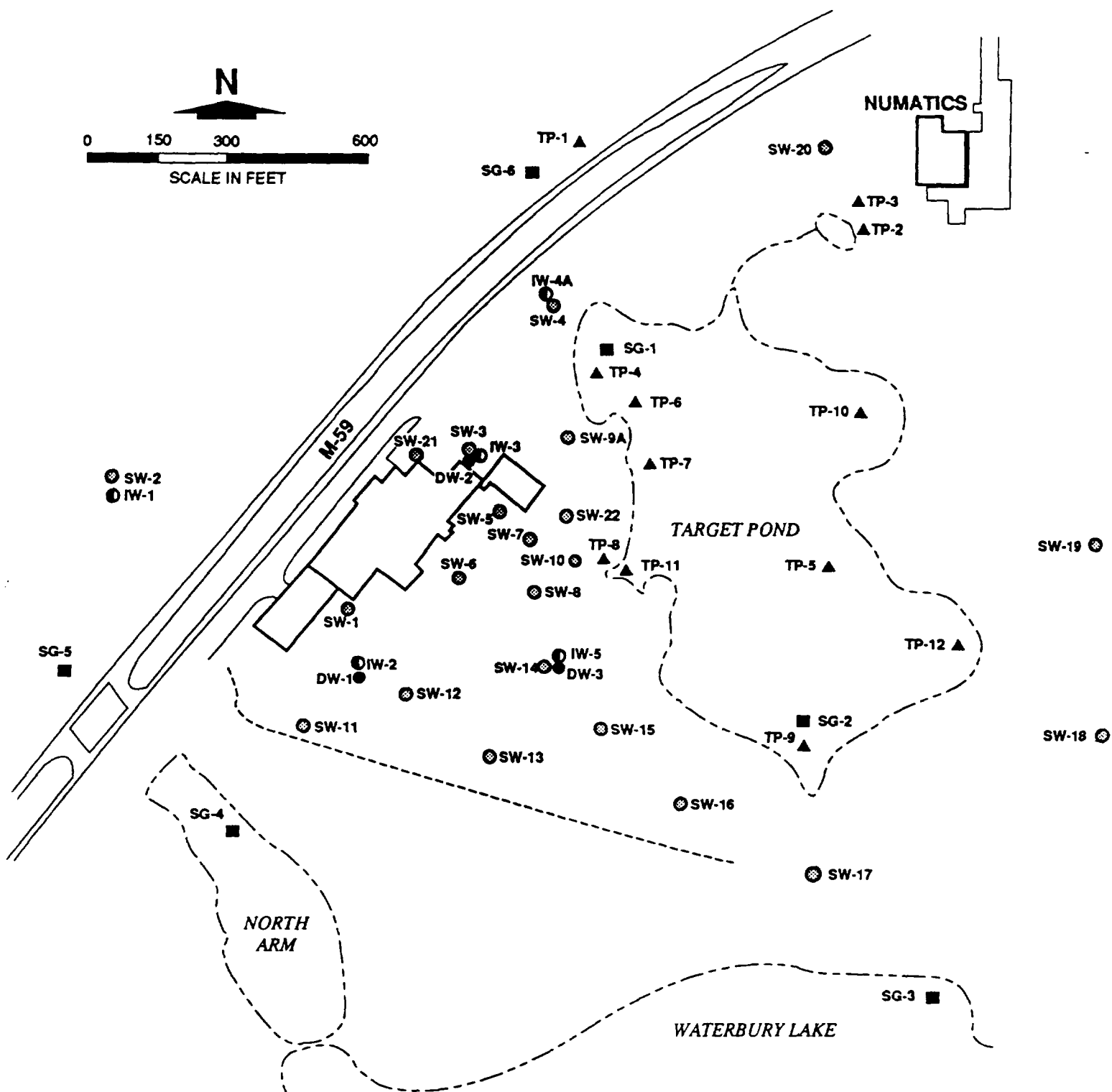
BG-1 ★ BACKGROUND SOIL

TP-1 ▲ TARGET WETLANDS (POND) SEDIMENT

● SOIL BORING

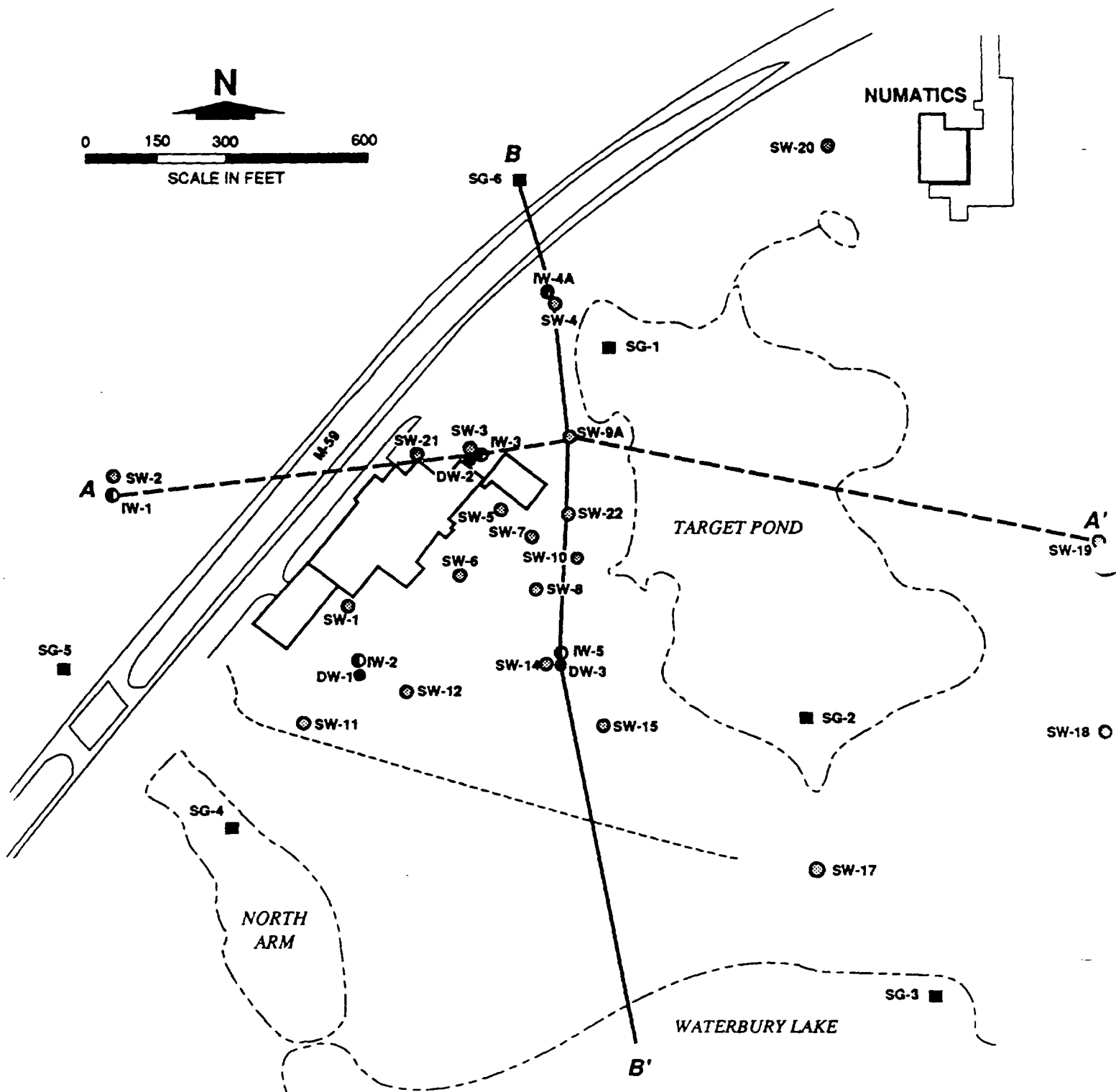
OG-1 ■ OFF GRID SAMPLING LOCATION

FIGURE 6
BACKGROUND SOIL,
SOIL & SURFACE WATER SEDIMENT
SAMPLING LOCATIONS
 HIMILL MANUFACTURING
 HIGHLAND MICHIGAN



LEGEND

- ⊗ SW-1 SHALLOW MONITORING WELL
- IW-1 INTERMEDIATE MONITORING WELL
- DW-1 DEEP MONITORING WELL
- SG-1 STAFF GAUGE
- ▲ TP-1 TARGET WETLAND (POND)

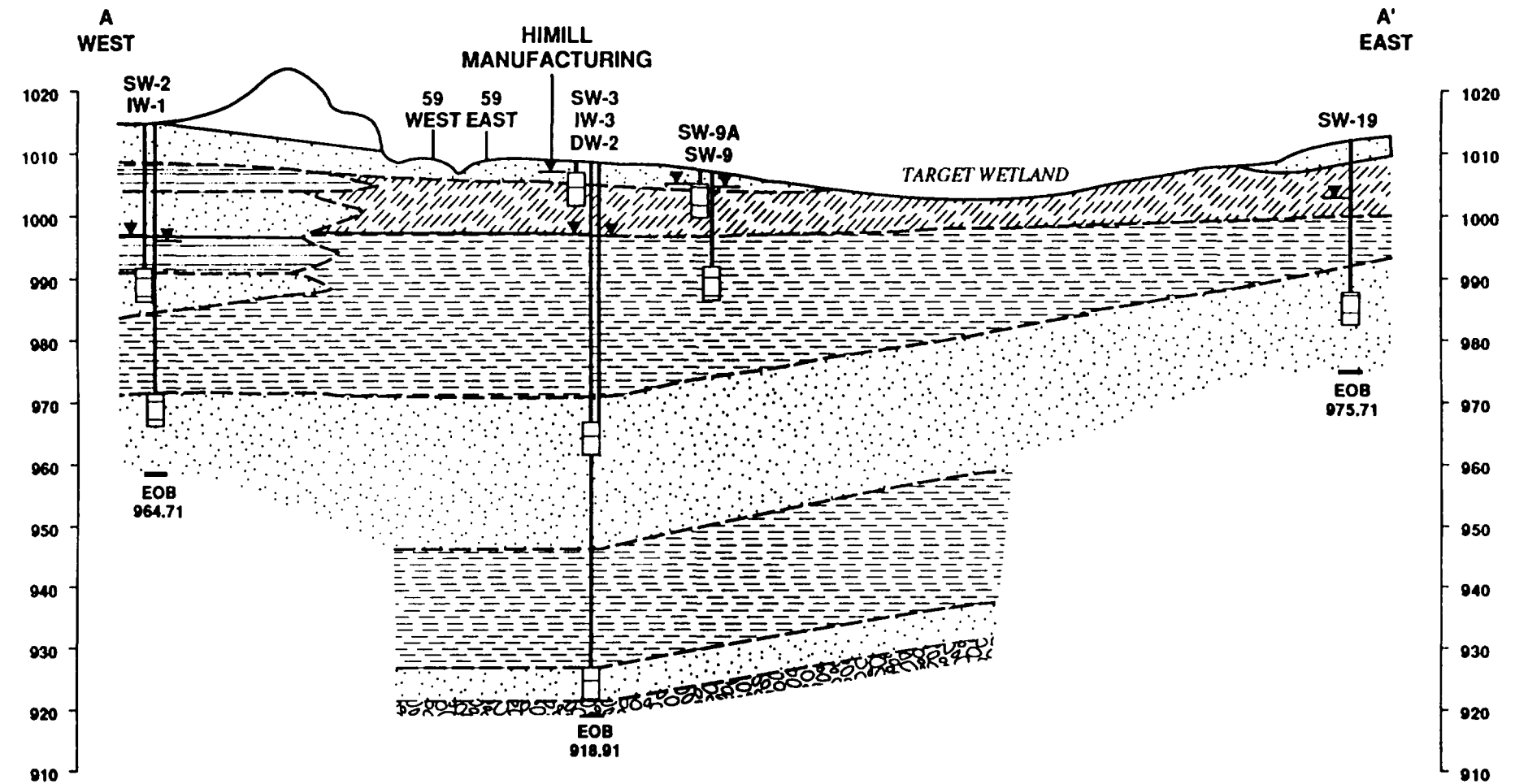


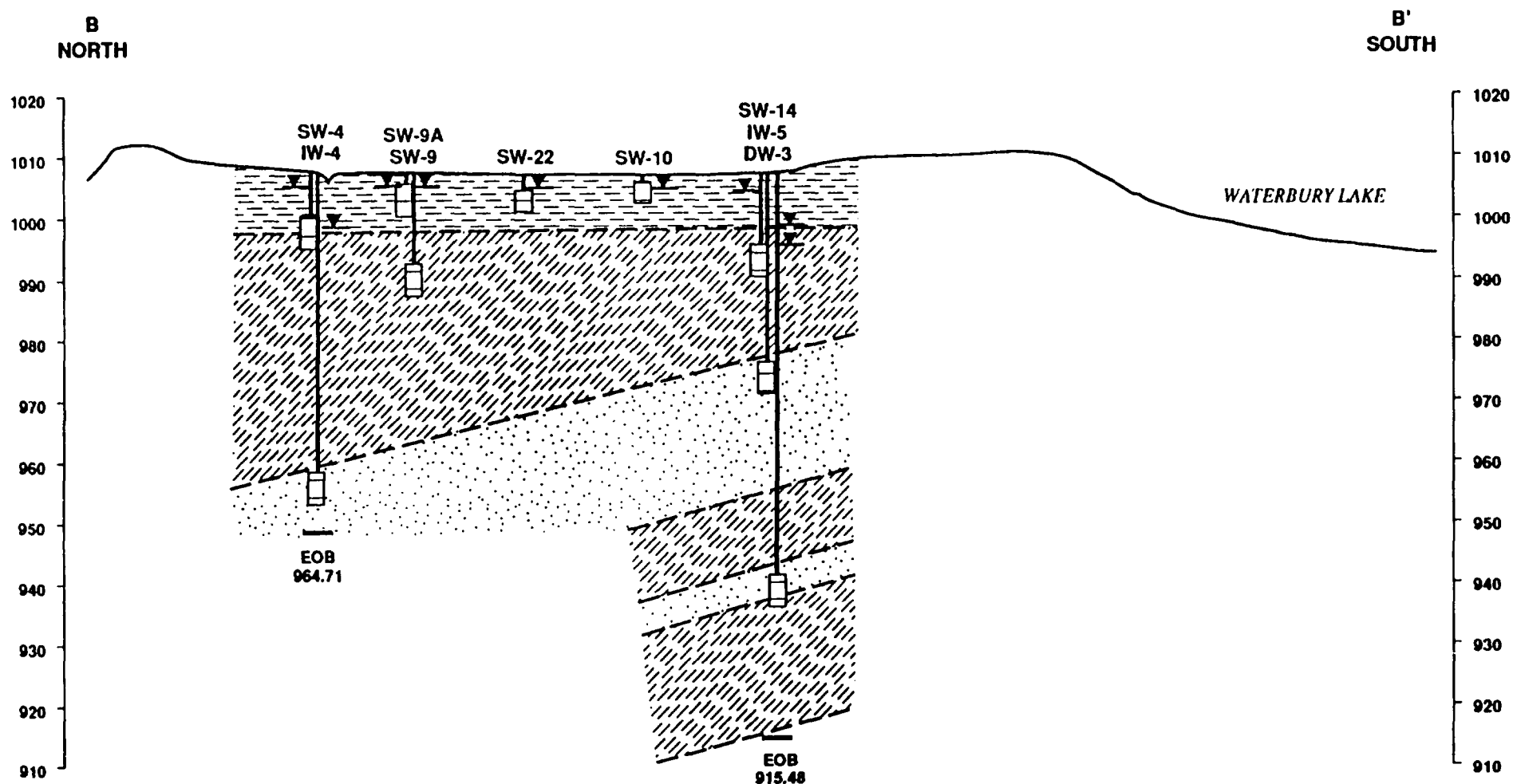
LEGEND

- SW-1 SHALLOW MONITORING WELL
- IW-1 INTERMEDIATE MONITORING WELL
- DW-1 DEEP MONITORING WELL
- SG-1 STAFF GAUGE

- A-A' CROSS SECTION LOCATION
- B-B' CROSS SECTION LOCATION

FIGURE 8
CROSS SECTION LOCATIONS
A-A' AND B-B'
 HIMILL MANUFACTURING
 HIGHLAND MICHIGAN





0 100 200 400
 HORIZONTAL SCALE IN FEET
 VERTICAL EXAGGERATION 10X



LEGEND






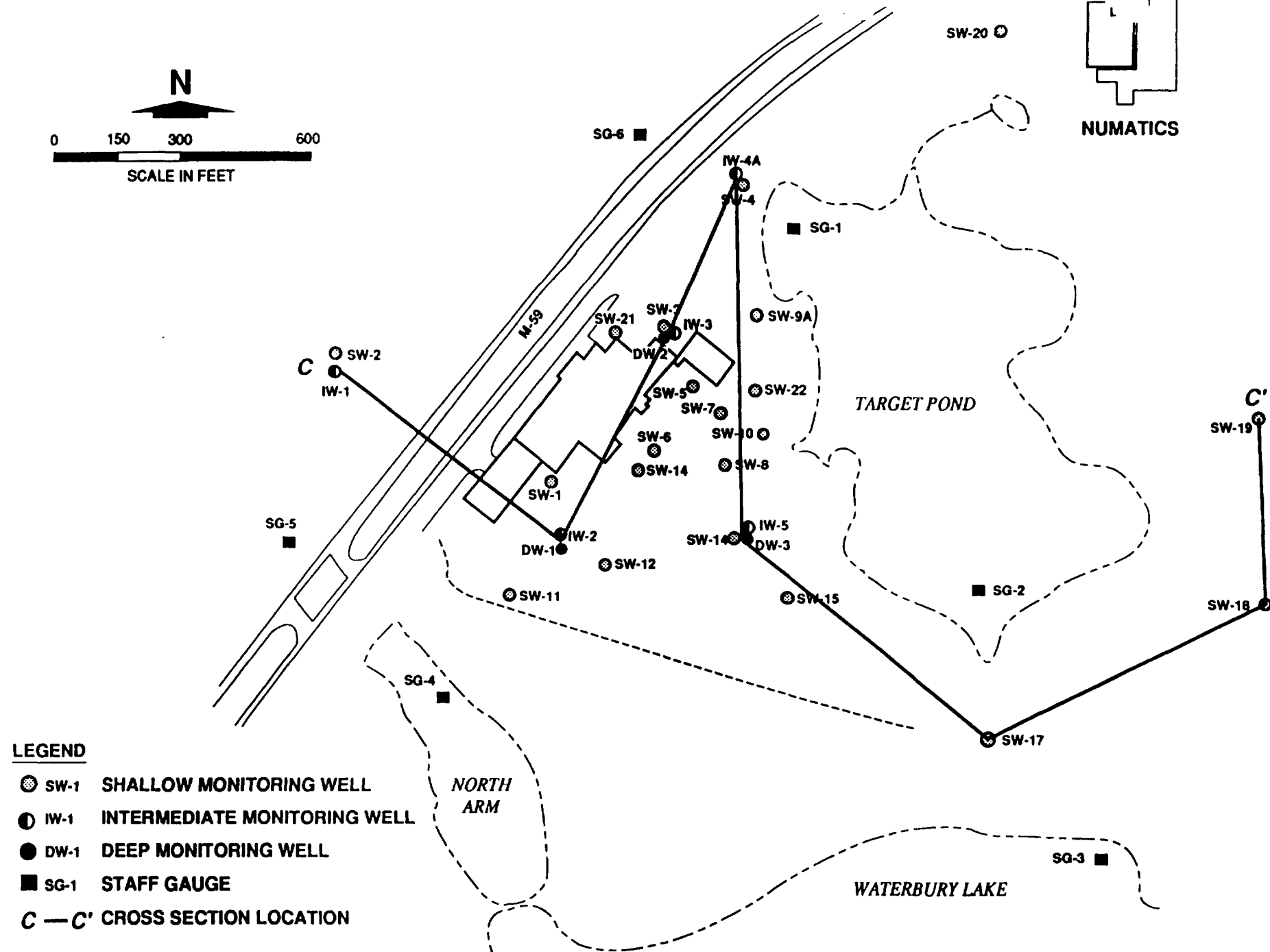
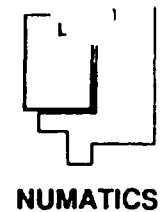
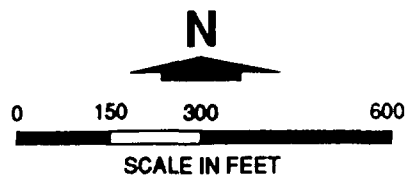
-  SAND
-  SILT
-  BROWN CLAY
-  BLUE CLAY
-  GRAVEL

FIGURE 10
GEOLOGIC
CROSS SECTION B-B'
 HIMILL MANUFACTURING
 HIGHLAND, MICHIGAN



LEGEND

- ⊙ SW-1 SHALLOW MONITORING WELL
- ① IW-1 INTERMEDIATE MONITORING WELL
- DW-1 DEEP MONITORING WELL
- SG-1 STAFF GAUGE
- C — C' CROSS SECTION LOCATION

FIGURE 11
C-C' CROSS SECTION LOCATION
HIMILL MANUFACTURING
HIGHLAND MICHIGAN

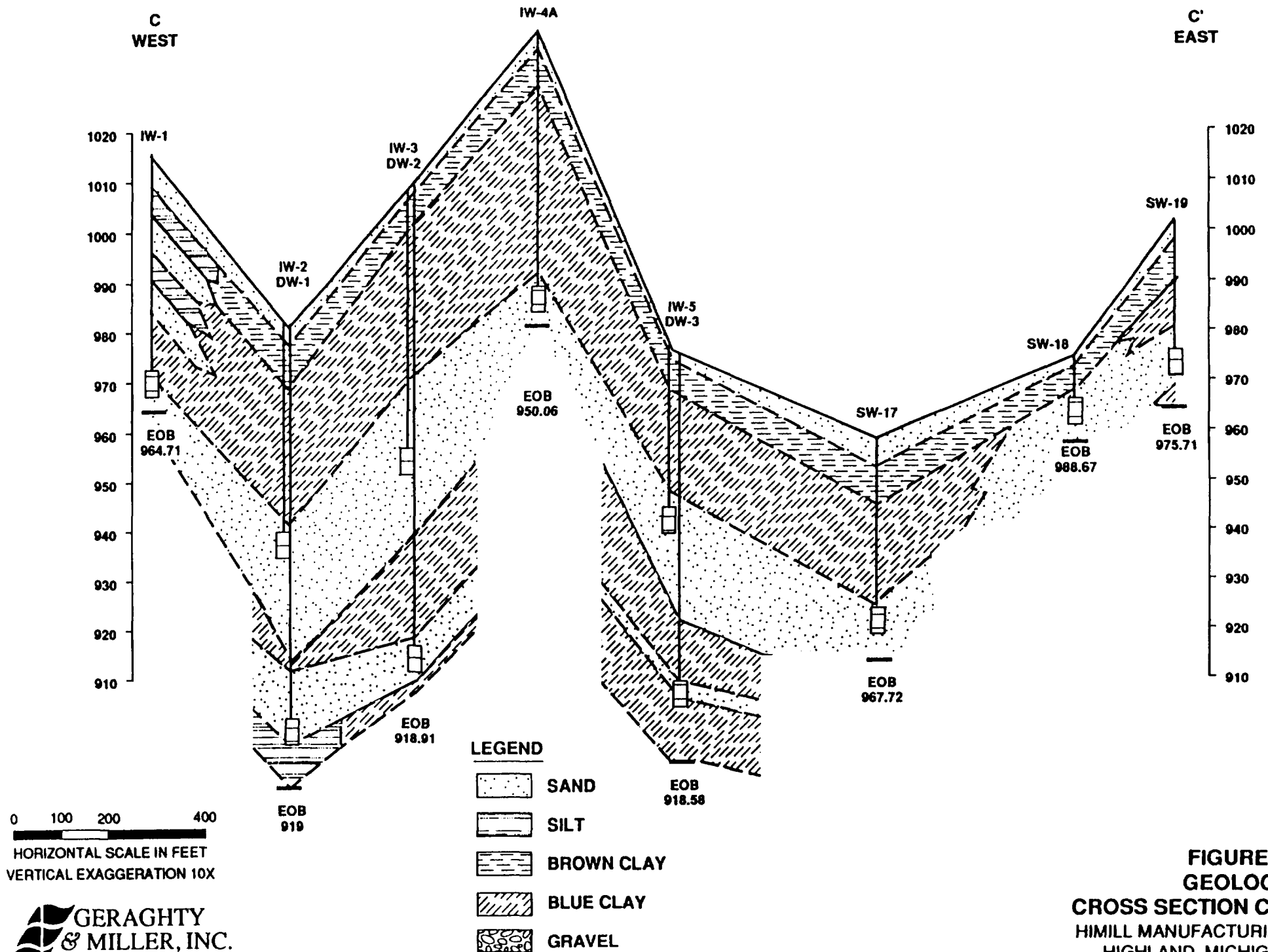
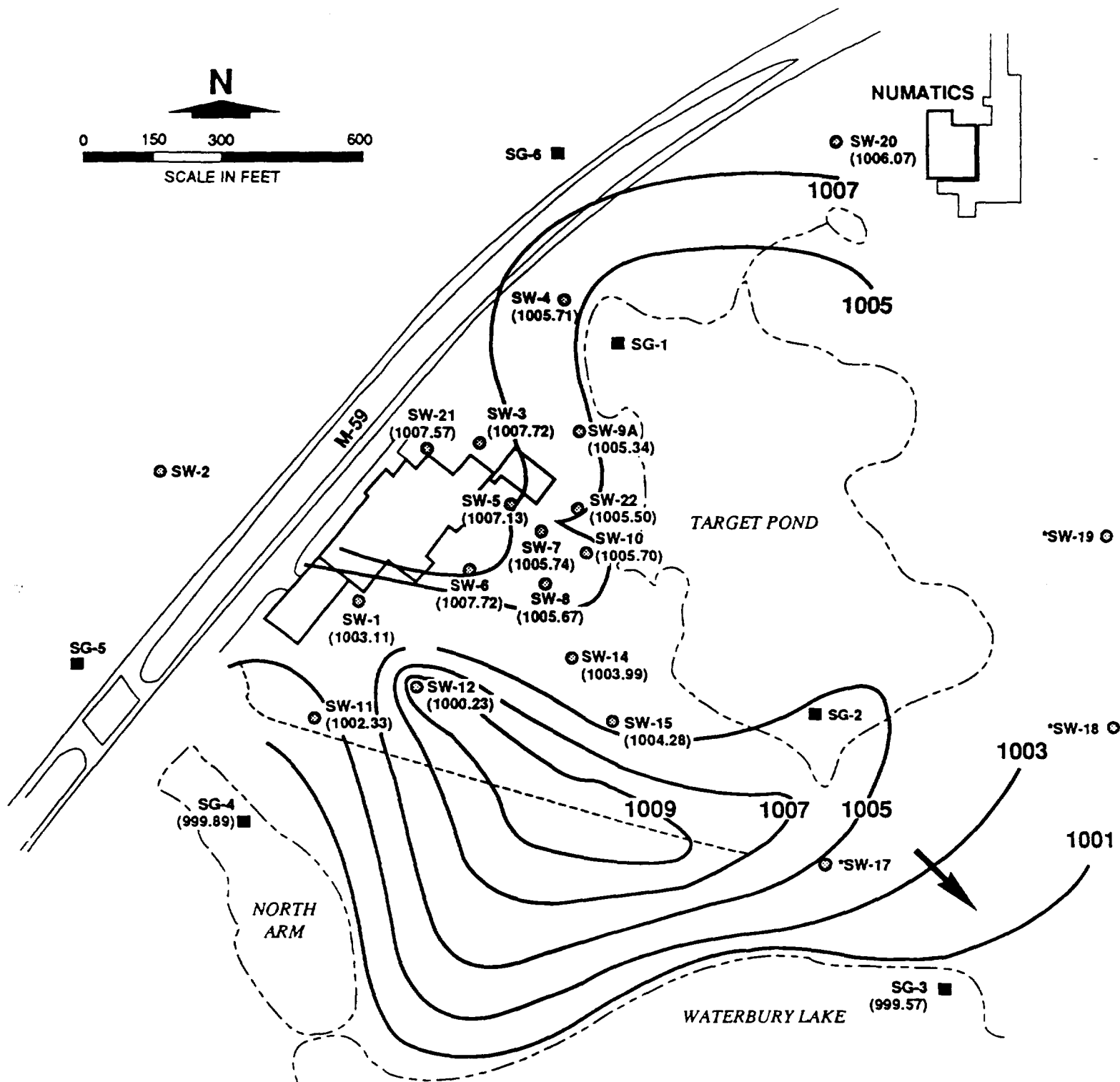


FIGURE 12
GEOLOGIC
CROSS SECTION C-C'
 HIMILL MANUFACTURING
 HIGHLAND, MICHIGAN

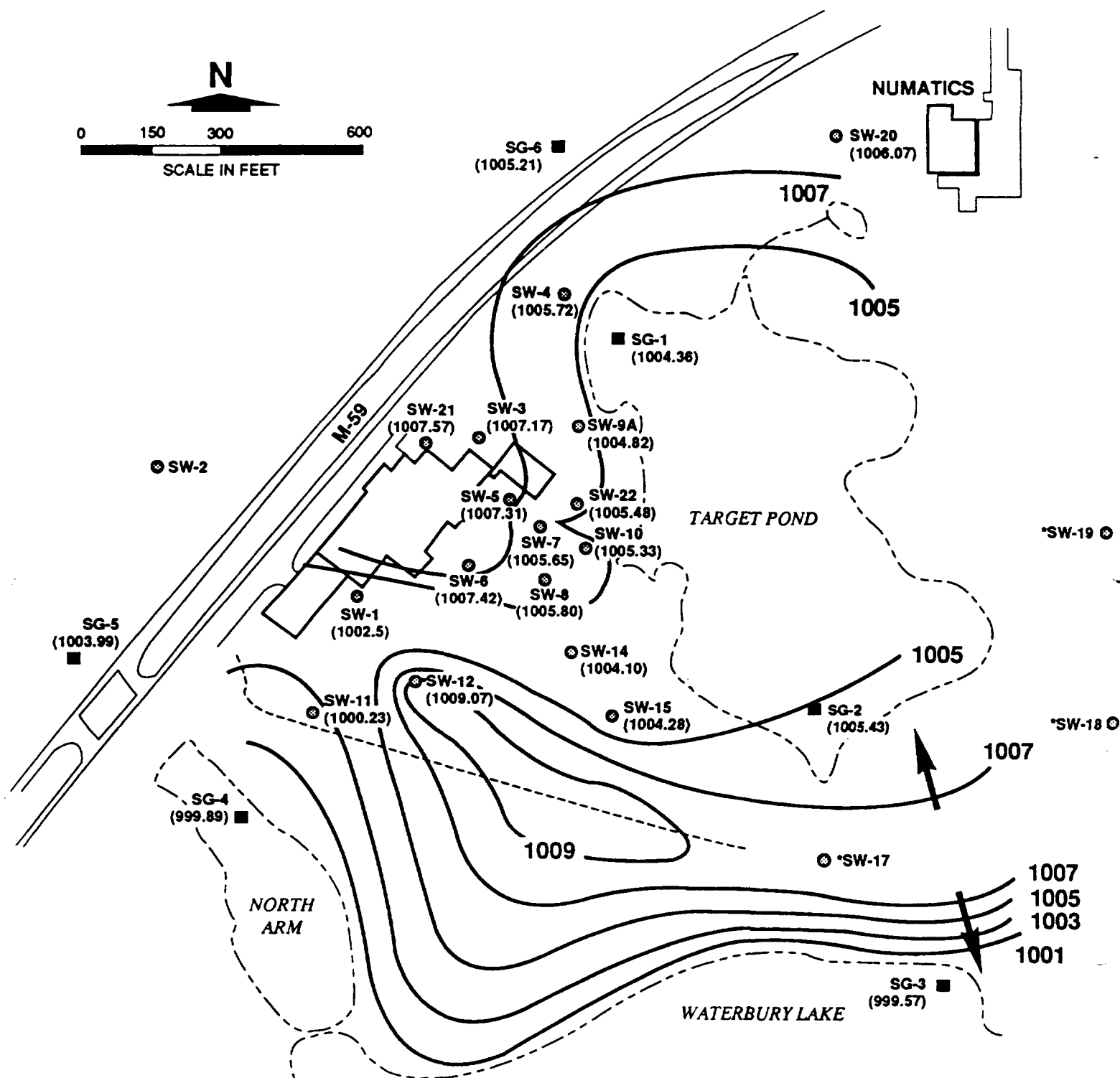


LEGEND

- SW-1 SHALLOW MONITORING WELL
- SG-1 STAFF GAUGE
- EQUIPOTENTIAL LINE
- ➔ GROUND WATER FLOW DIRECTION

NOTE: *Shallow designation but screened in intermediate aquifer.

FIGURE 13
HYDRAULIC CONNECTION
BETWEEN TARGET POND
AND WATERBURY LAKE
JUNE 8, 1990
HIMILL MANUFACTURING
HIGHLAND MICHIGAN



LEGEND

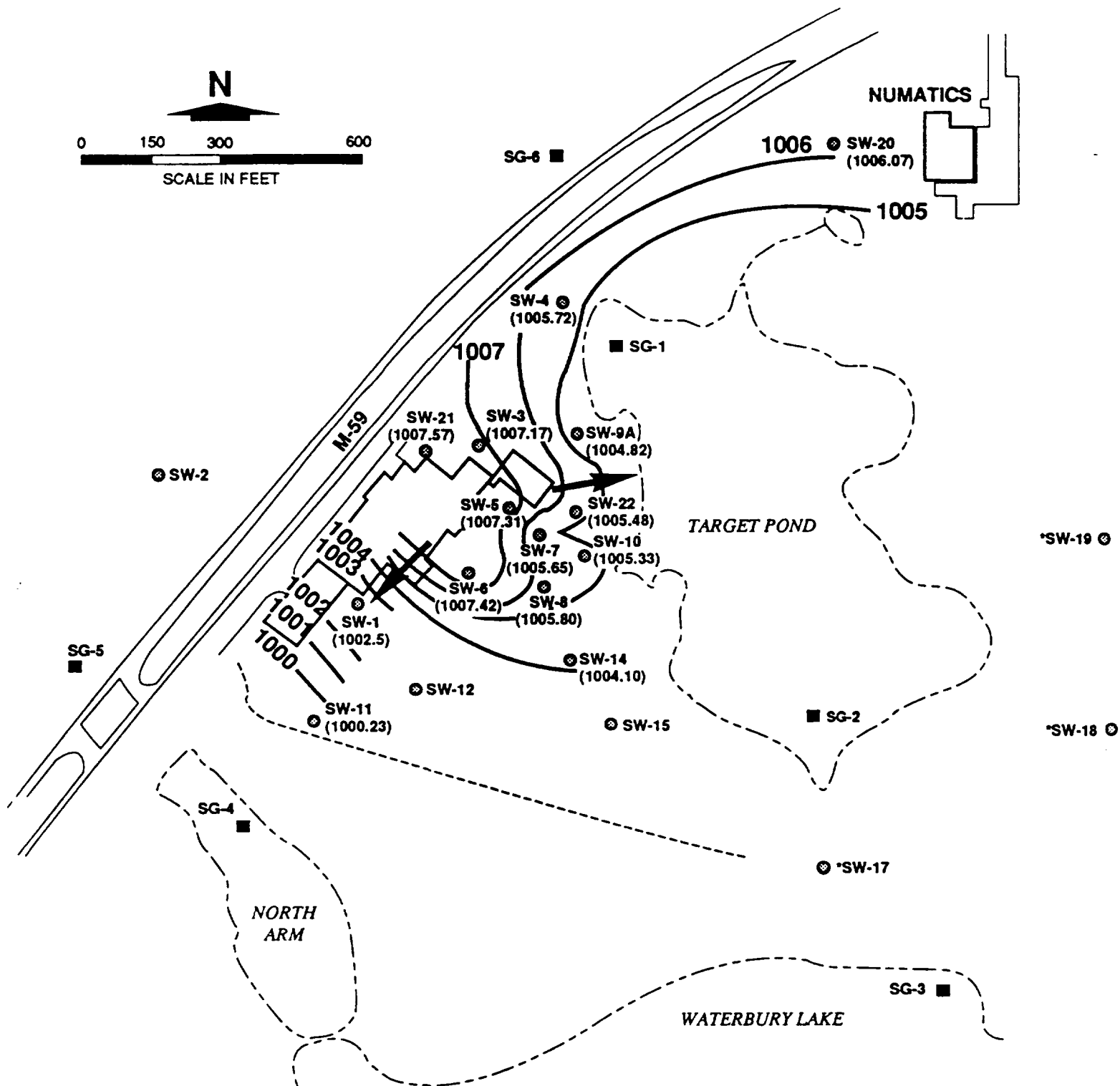
- ⊙ SW-1 SHALLOW MONITORING WELL
- SG-1 STAFF GAUGE
- EQUIPOTENTIAL LINE
- GROUND WATER FLOW DIRECTION

NOTE: *Shallow designation but screened in intermediate aquifer.

FIGURE 14
NO HYDRAULIC CONNECTION
BETWEEN TARGET POND
AND WATERBURY LAKE

JUNE 8, 1990

HIMILL MANUFACTURING
 HIGHLAND MICHIGAN



LEGEND

- ⊗ SW-1 SHALLOW MONITORING WELL
- SG-1 STAFF GAUGE
- EQUIPOTENTIAL LINE
- ← GROUNDWATER FLOW DIRECTION

NOTE: *Shallow designation but screened in intermediate aquifer.

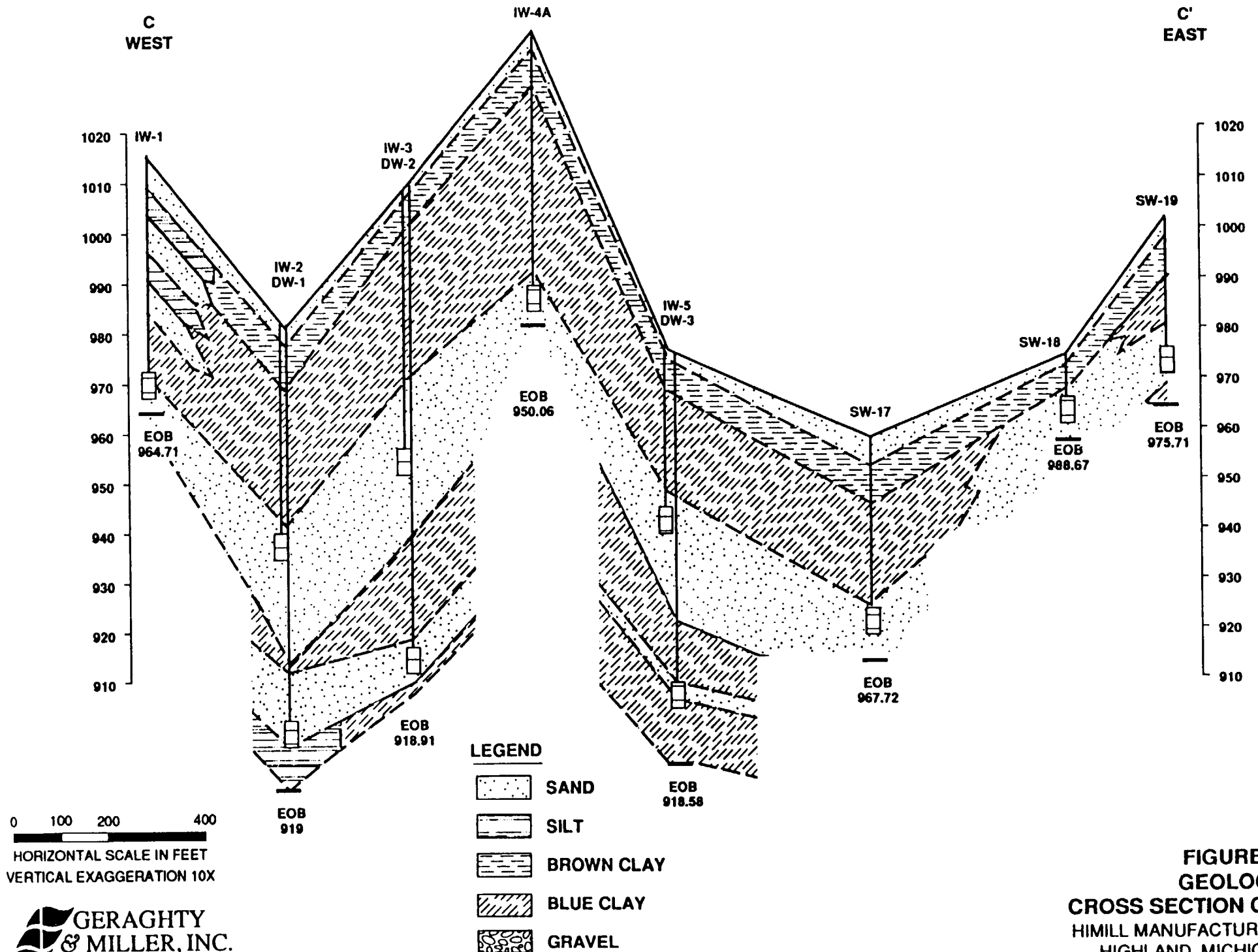
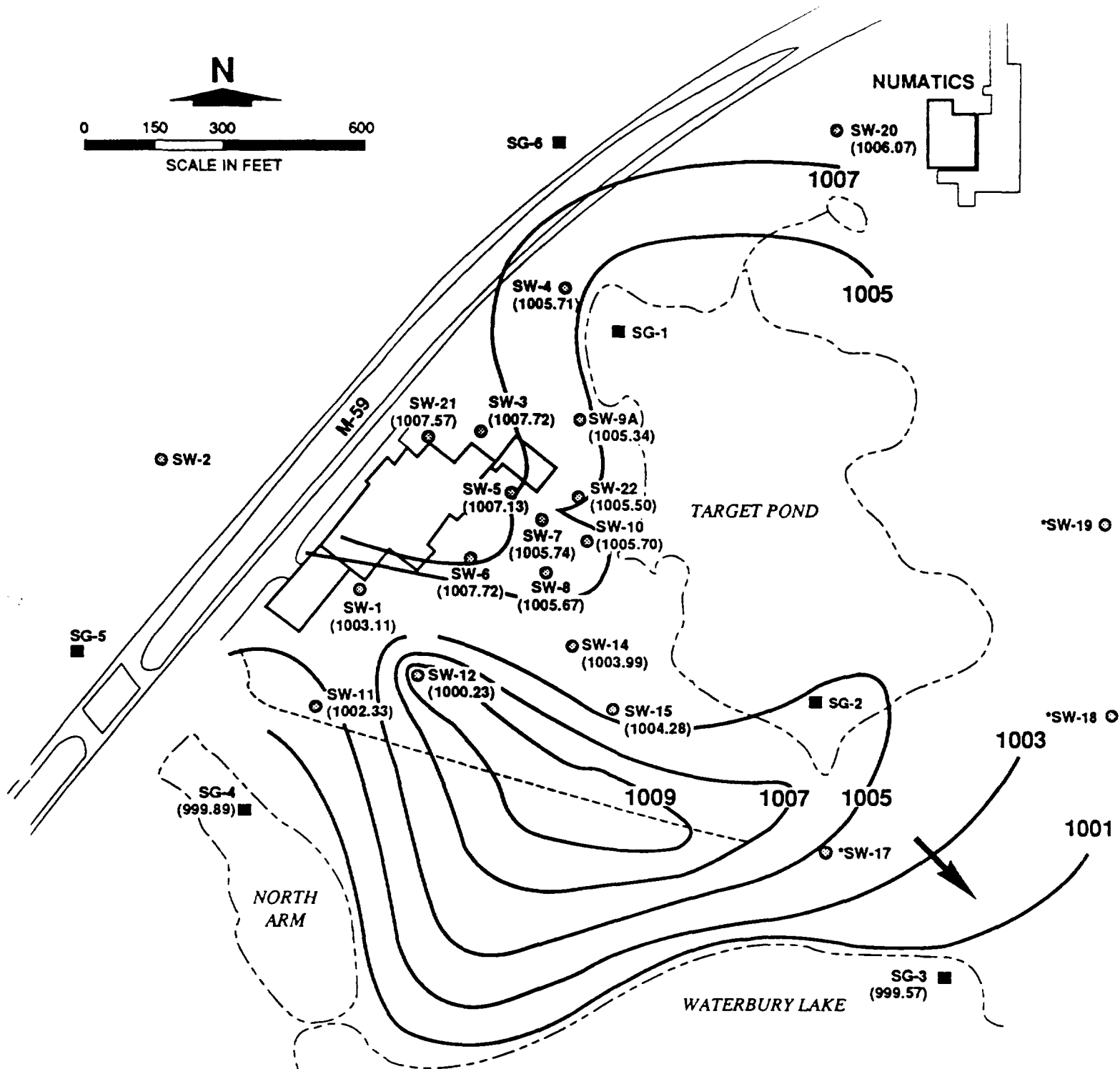


FIGURE 12
GEOLOGIC
CROSS SECTION C-C'
 HIMILL MANUFACTURING
 HIGHLAND, MICHIGAN



LEGEND

- ⊙ SW-1 SHALLOW MONITORING WELL
- SG-1 STAFF GAUGE
- EQUIPOTENTIAL LINE
- ➔ GROUND WATER FLOW DIRECTION

NOTE: *Shallow designation but screened in intermediate aquifer.

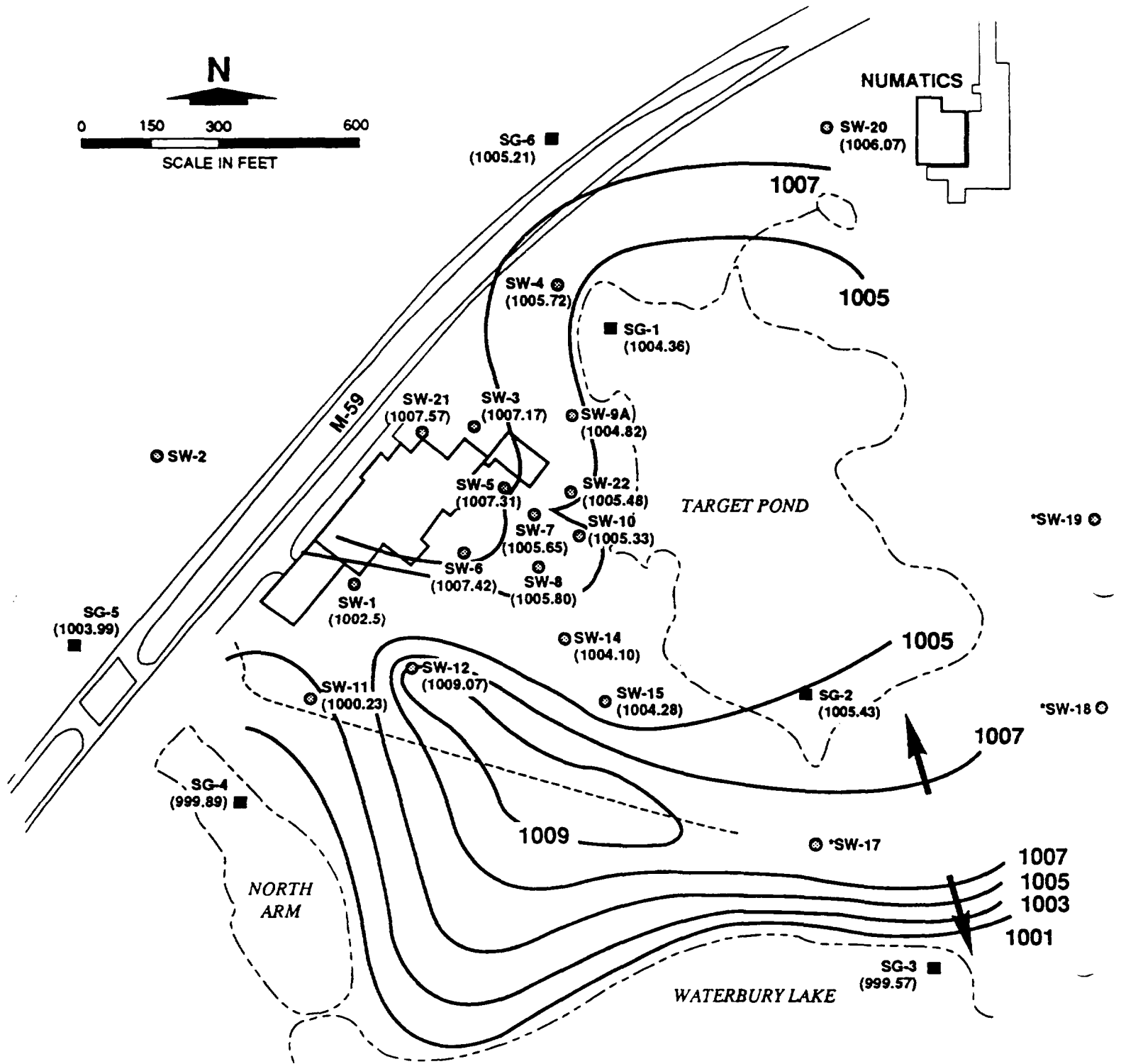
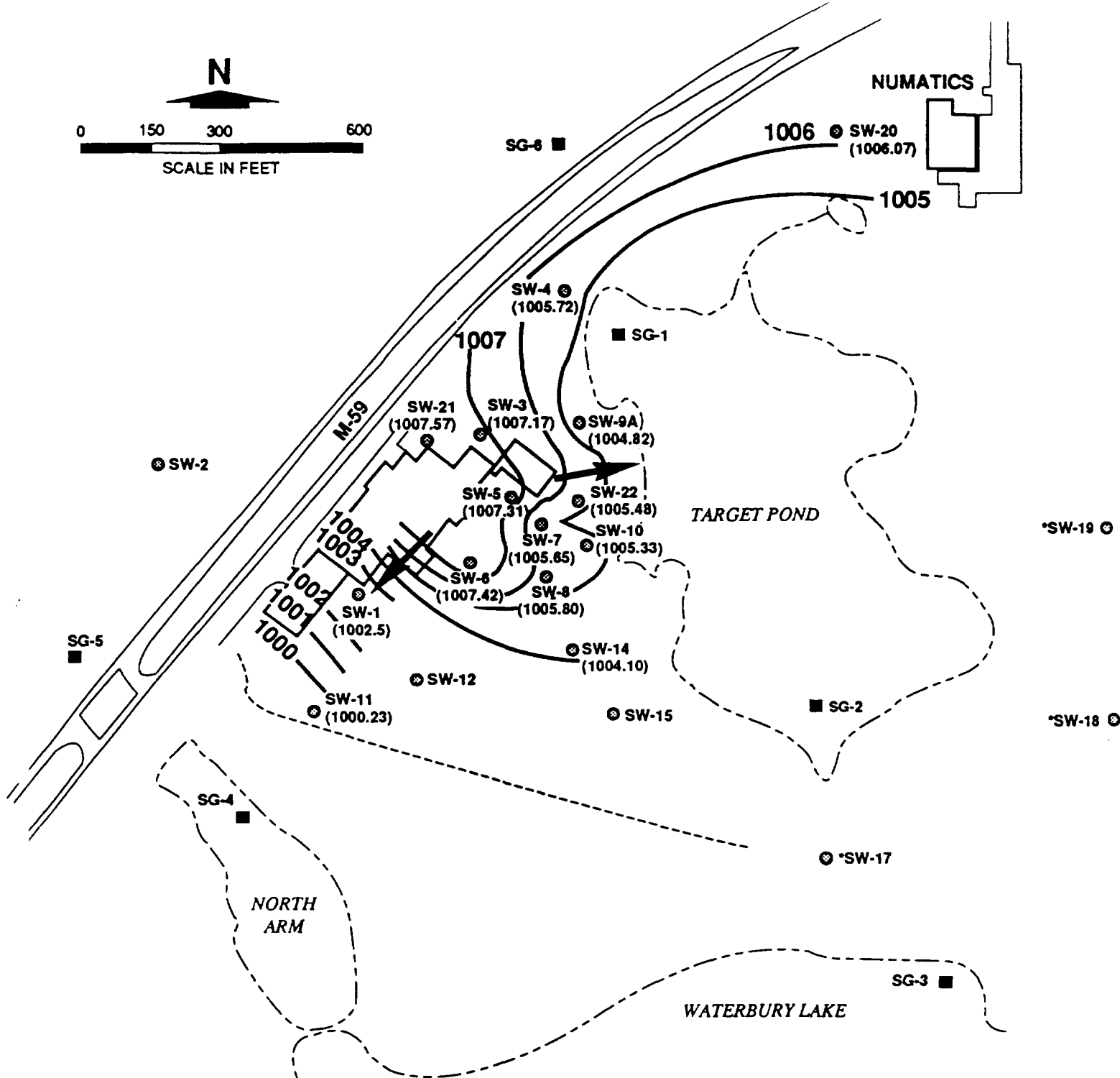


FIGURE 14
NO HYDRAULIC CONNECTION
BETWEEN TARGET POND
AND WATERBURY LAKE
JUNE 8, 1990
 HIMILL MANUFACTURING
 HIGHLAND MICHIGAN



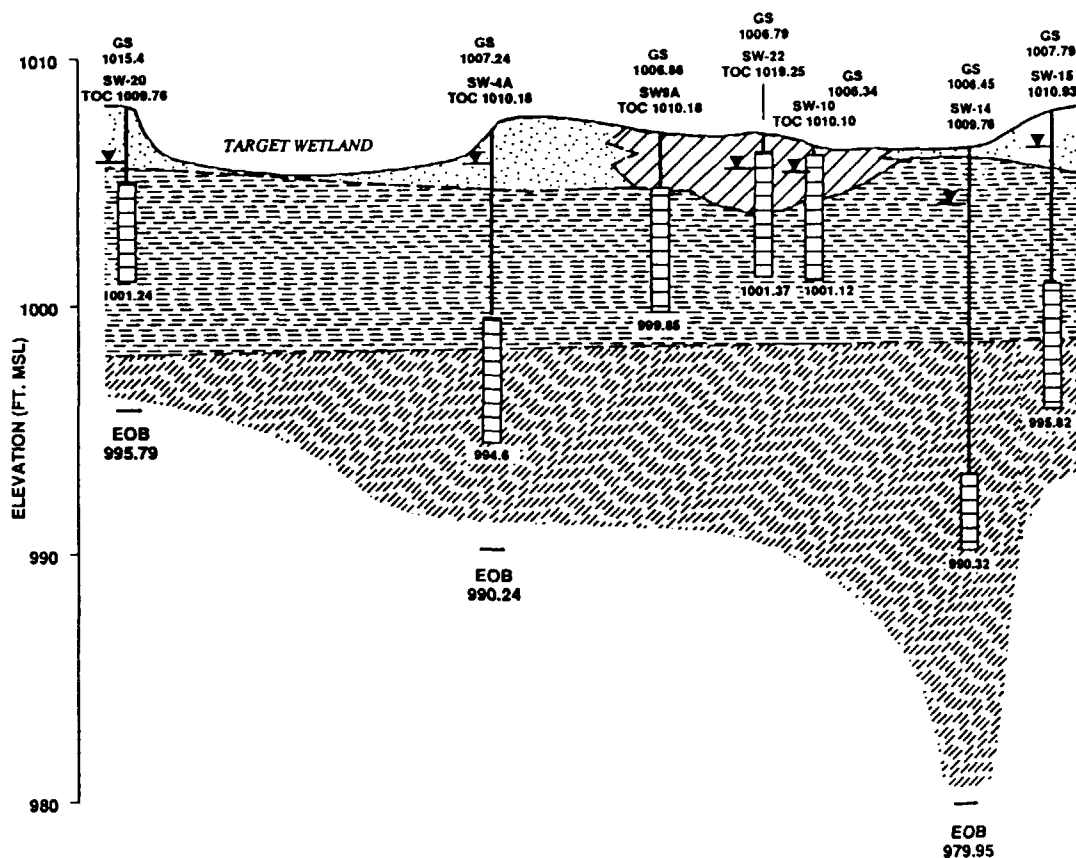
LEGEND

- ⊗ SW-1 SHALLOW MONITORING WELL
- SG-1 STAFF GAUGE
- EQUIPOTENTIAL LINE
- ➔ GROUNDWATER FLOW DIRECTION

NOTE: *Shallow designation but screened in intermediate aquifer.

FIGURE 15
SHALLOW WELLS
POTENTIOMETRIC SURFACE
OCTOBER 31, 1990
HIMILL MANUFACTURING
HIGHLAND MICHIGAN

NORTH

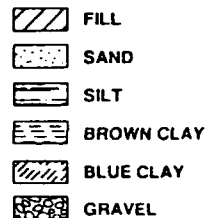


0 100 200 400

HORIZONTAL SCALE IN FEET

VERTICAL EXAGGERATION = 10X

LEGEND



GS GROUND SURFACE
TOC TOP OF CASING
EOB END OF BORING

GERAGHTY
& MILLER, INC.
Environmental Services

SOUTH

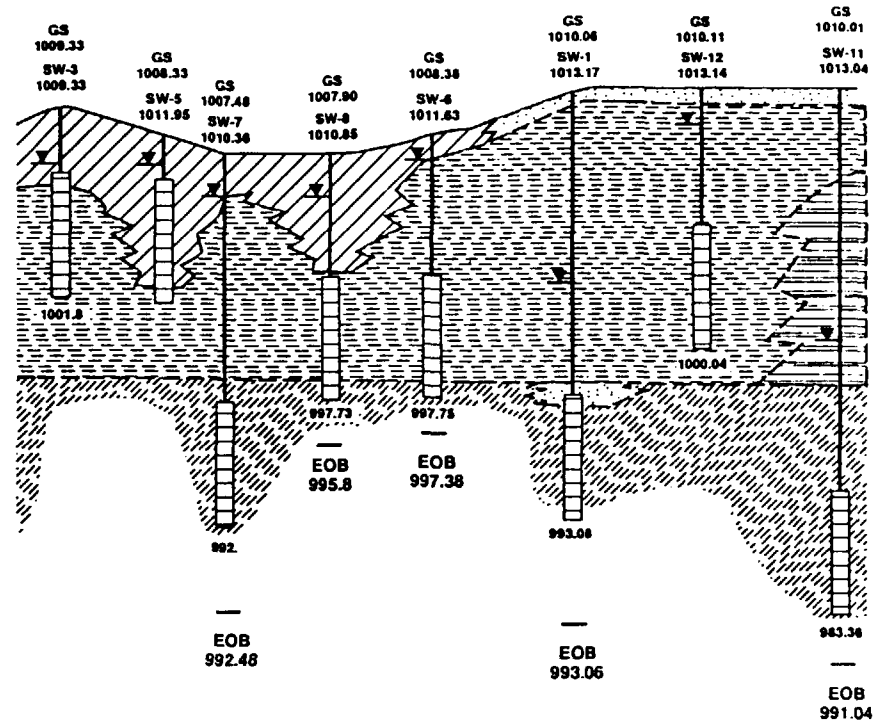
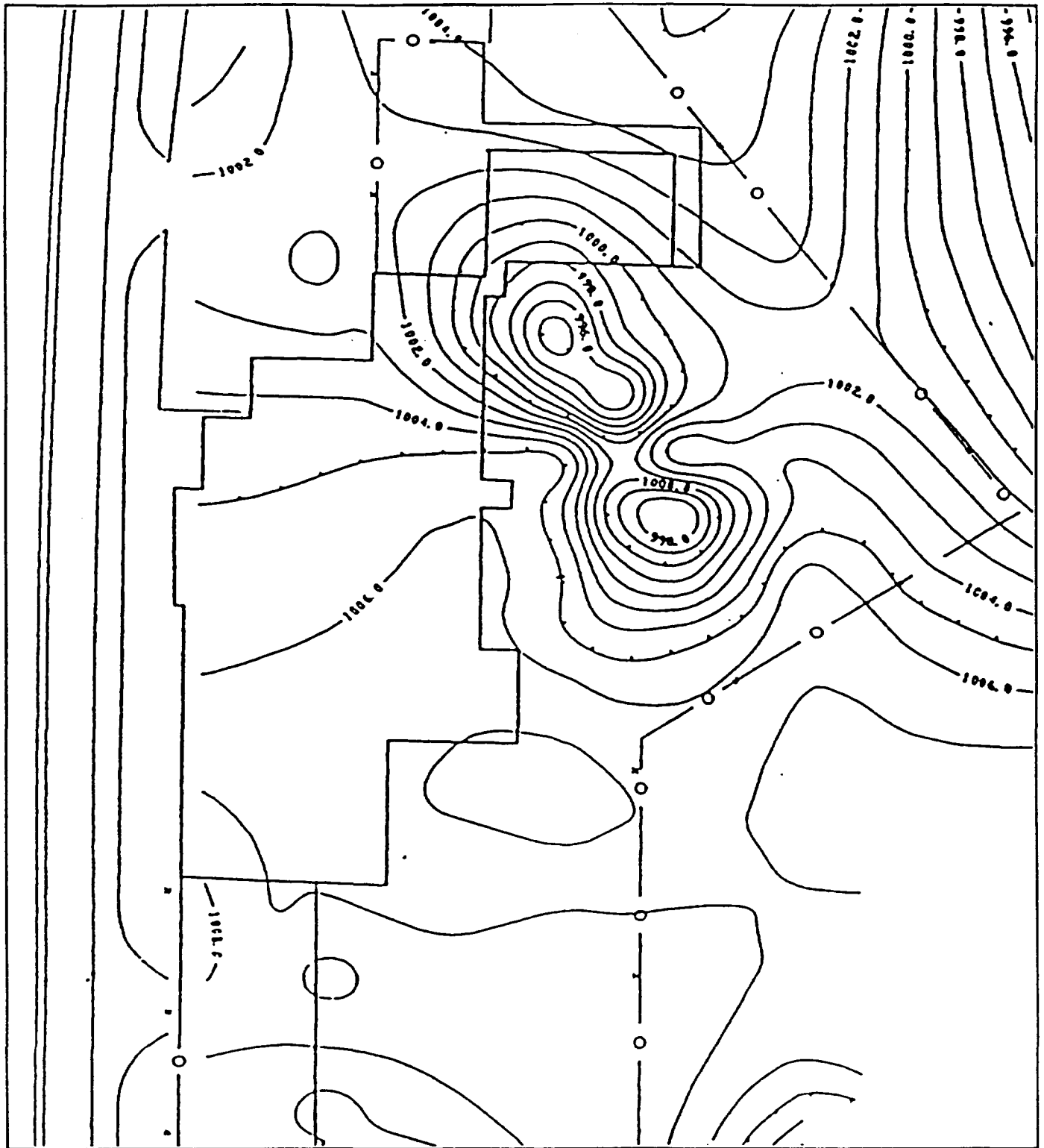
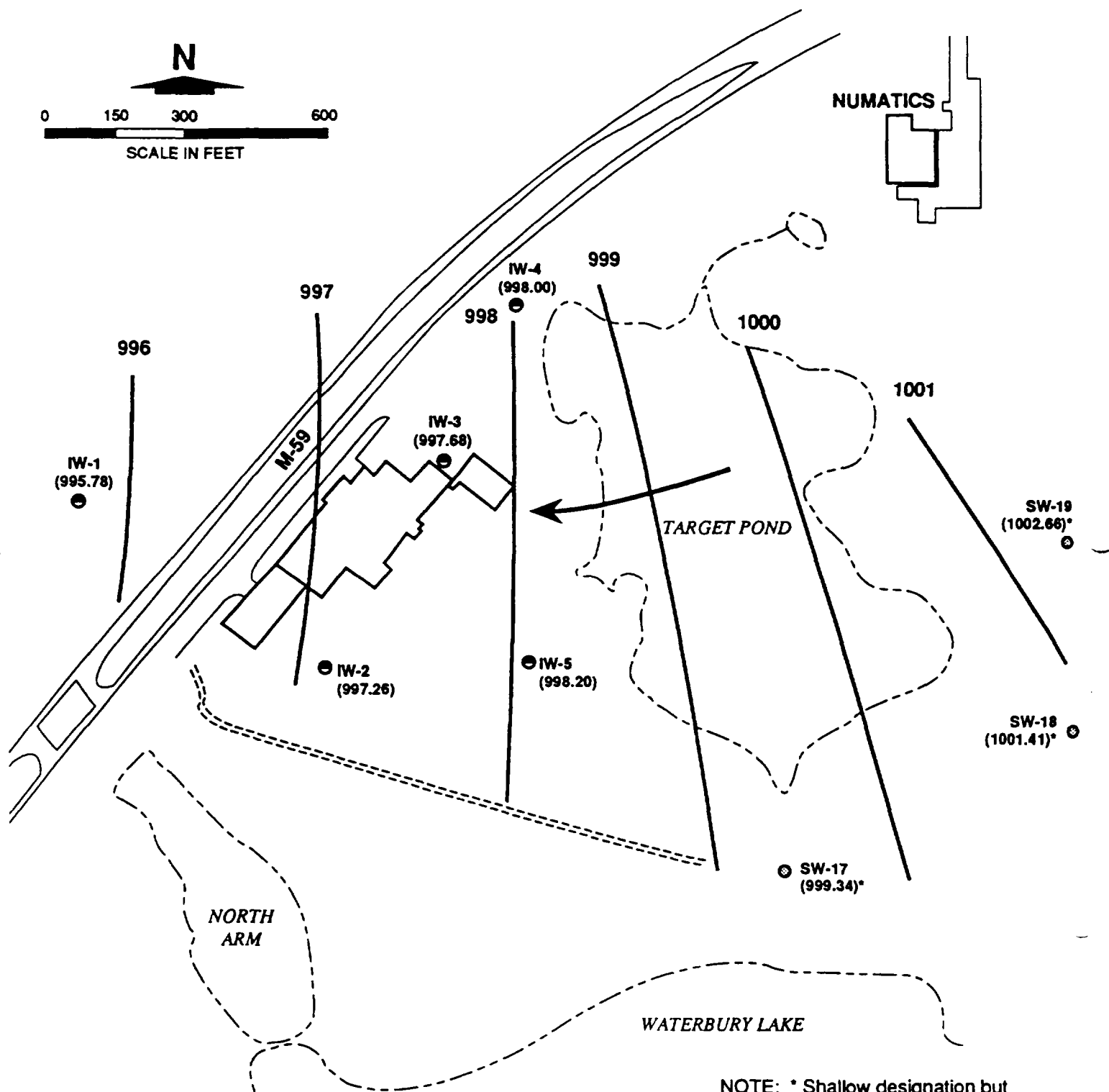


FIGURE 16
WELL SCREEN ELEVATIONS
SHALLOW WELLS
HIMILL MANUFACTURING
HIGHLAND, MICHIGAN



SOURCE: Techna Corporation Draft Remedial Investigation Report, June 1990

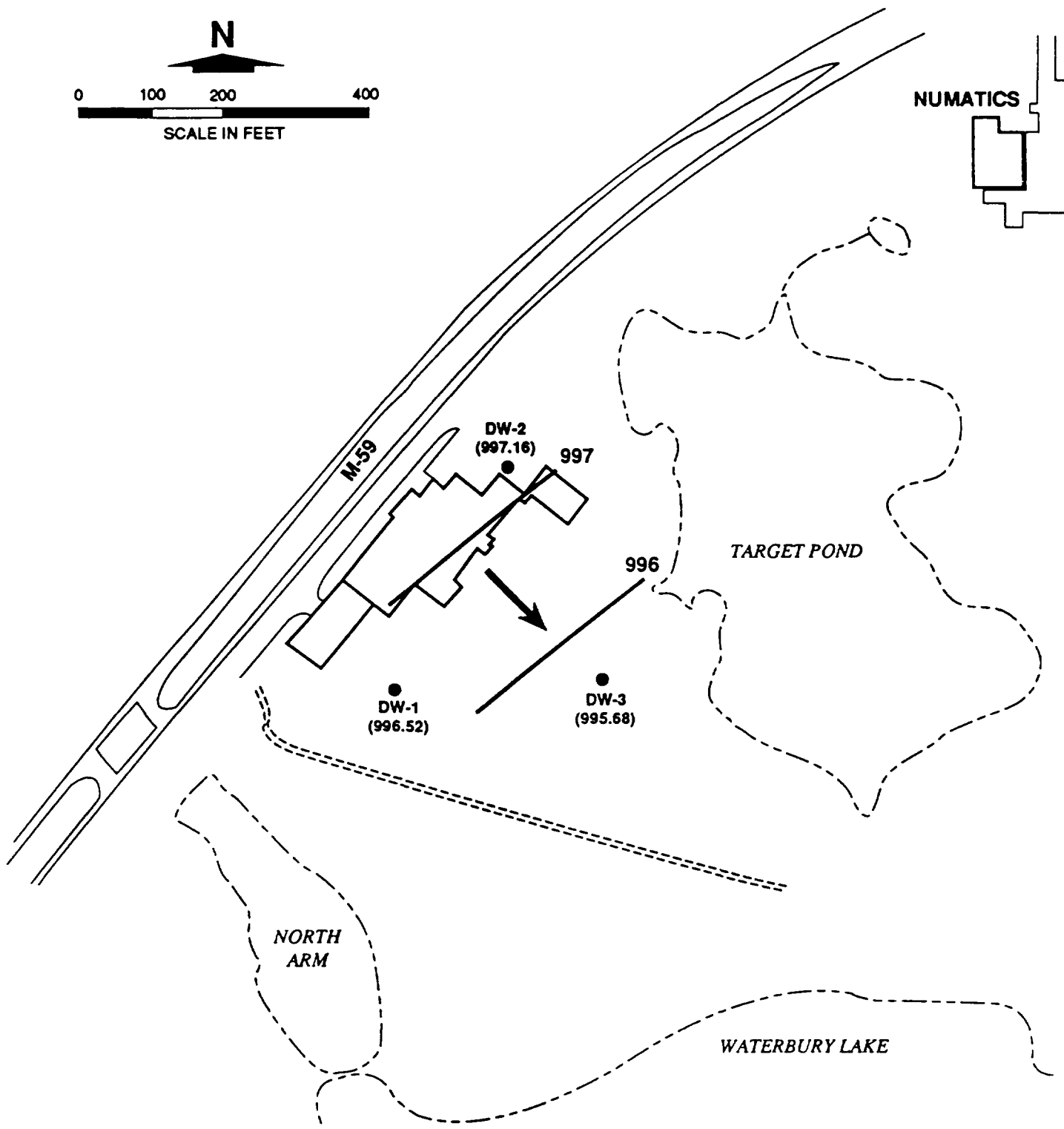




LEGEND

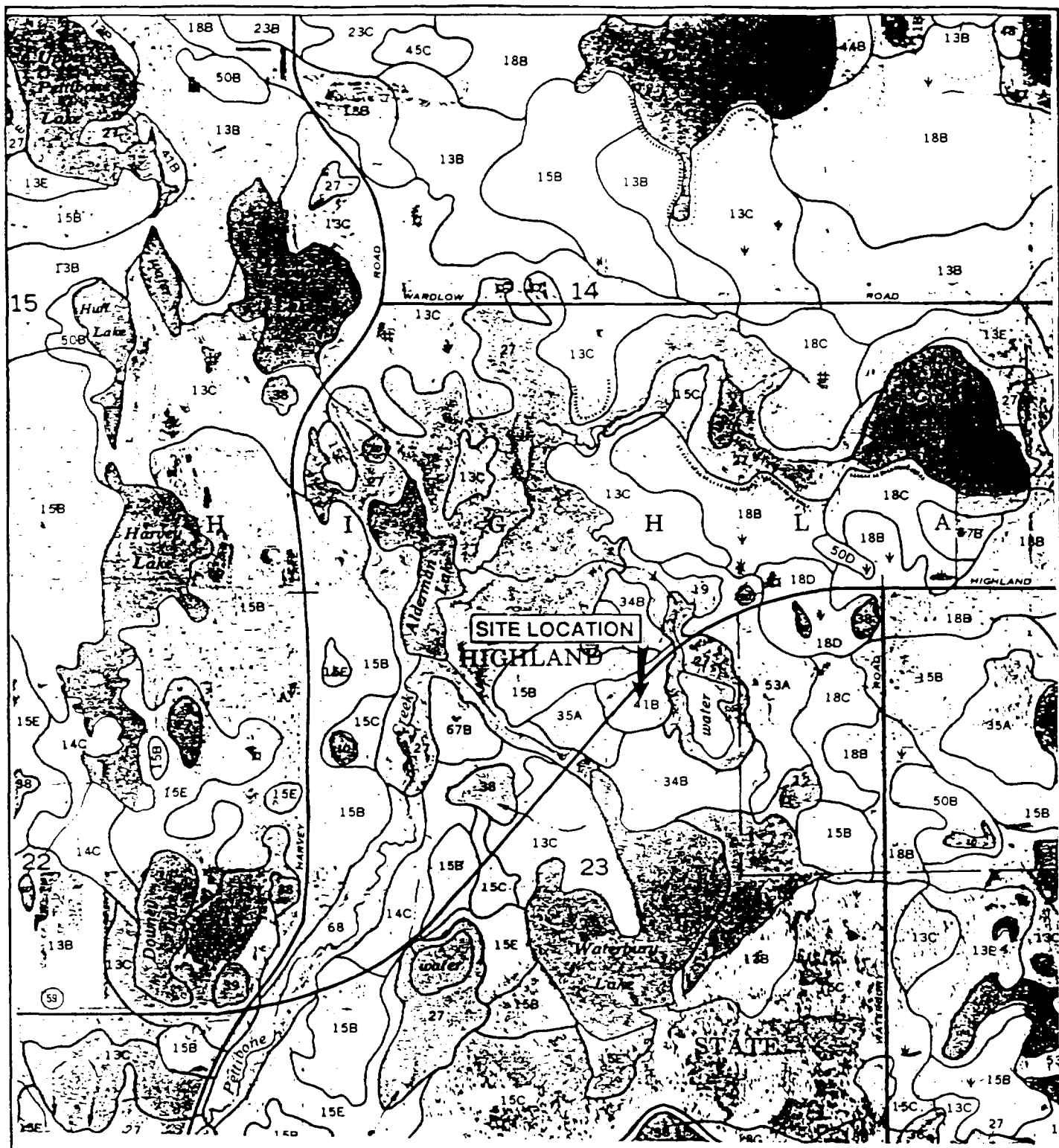
- IW-1 INTERMEDIATE MONITORING WELL
- ← GROUNDWATER FLOW DIRECTION
- 996 EQUIPOTENTIAL LINES

FIGURE 18
INTERMEDIATE WELLS
POTENTIOMETRIC SURFACE MAP
OCTOBER 31, 1990
HIMILL MANUFACTURING
HIGHLAND MICHIGAN



LEGEND

- DW-1 DEEP MONITORING WELL
- 997 EQUIPOTENTIAL LINE
- ← GROUNDWATER FLOW DIRECTION



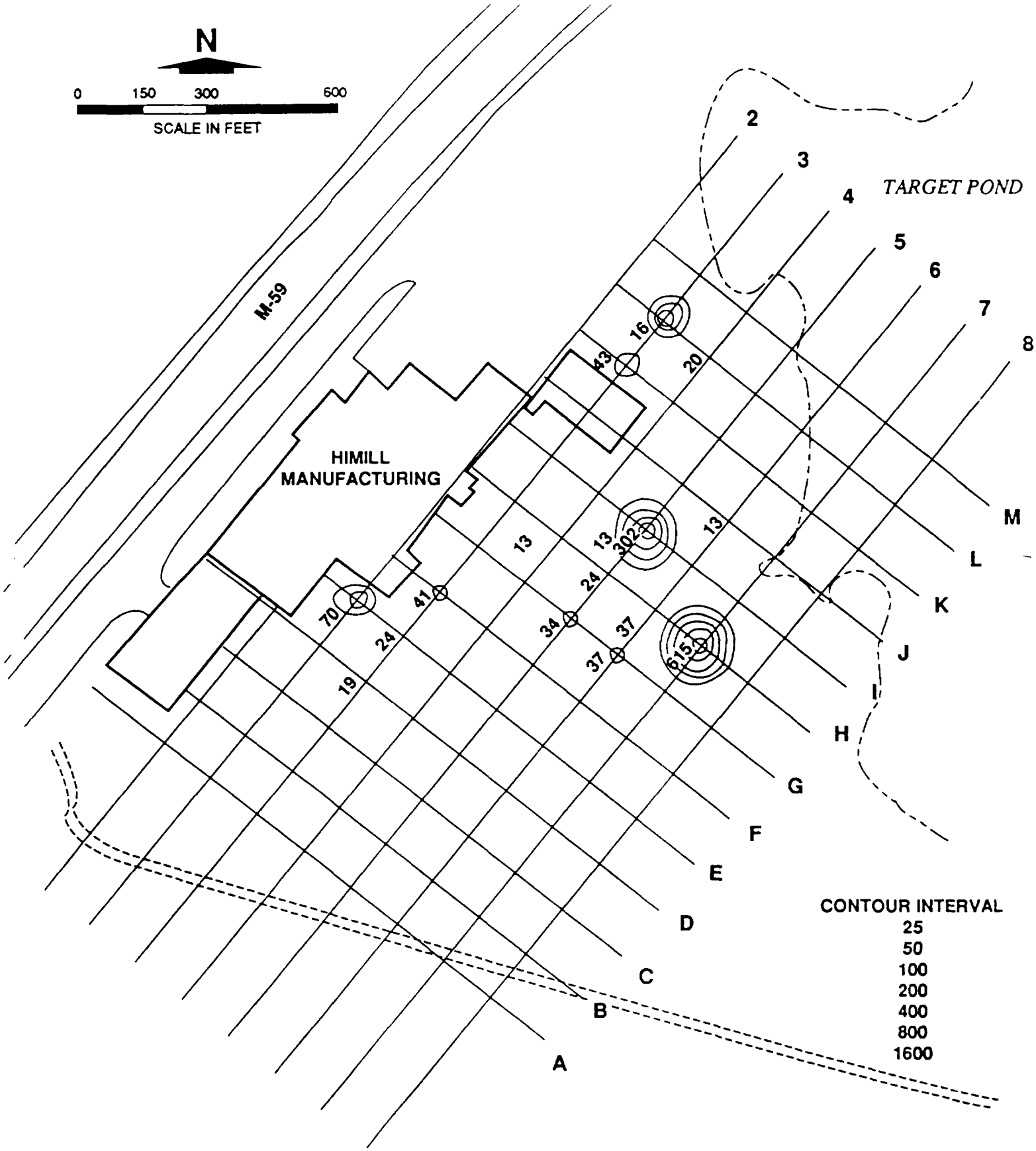
SOURCE: U.S. Department of Agriculture Soil Conservation Service Soil Survey of Oakland Co. 1980

FIGURE 20
SOIL CLASSIFICATIONS
 HIMILL MANUFACTURING
 HIGHLAND, MICHIGAN

SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and letters. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas.

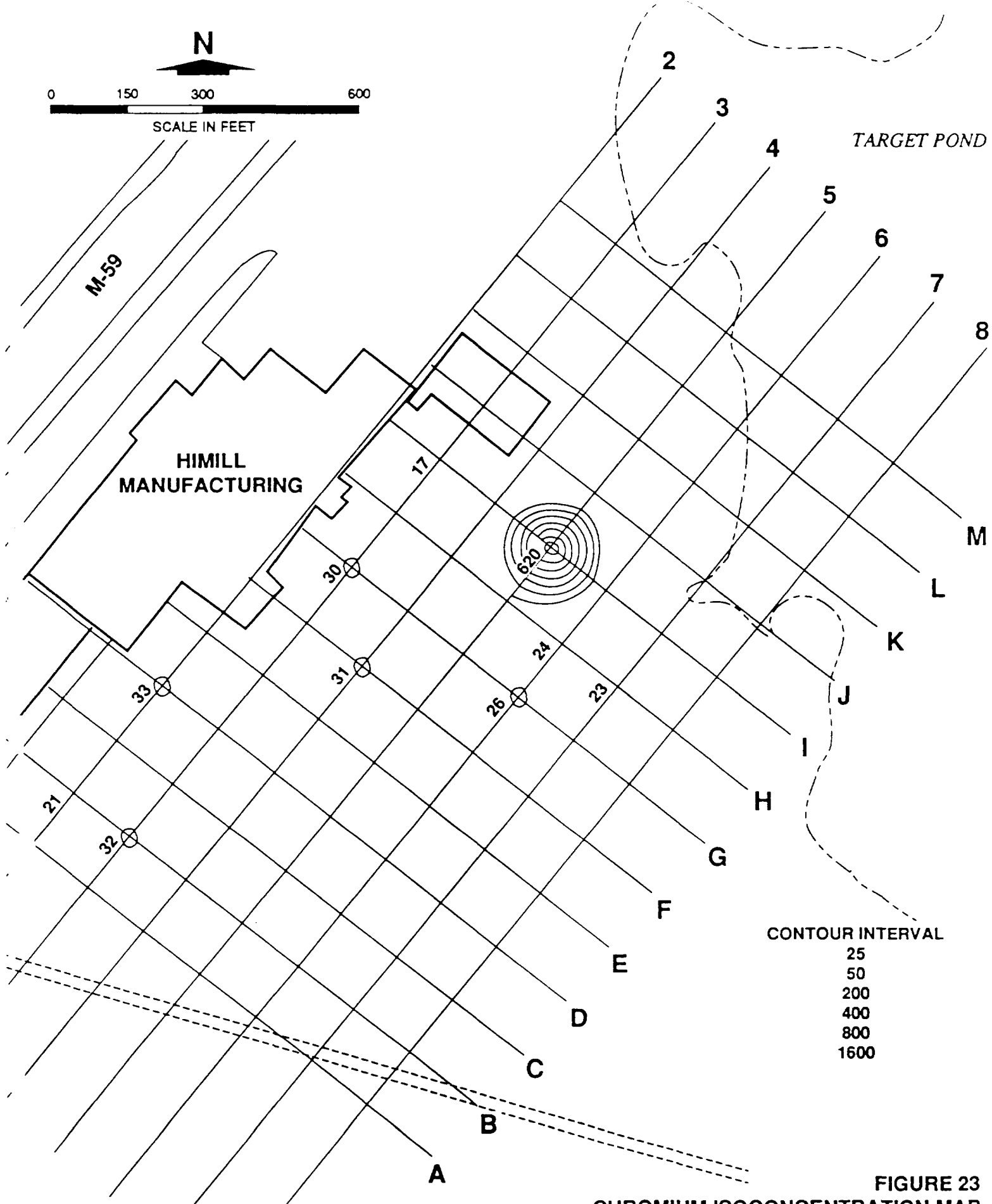
SYMBOL	NAME	SYMBOL	NAME
10B	Marlette sandy loam, 1 to 6 percent slopes	40B	Udorthents, loamy, undulating
10C	Marlette sandy loam, 6 to 12 percent slopes	40C	Udorthents, loamy, rolling
10D	Marlette loam, 12 to 18 percent slopes	41B	Aquents, sandy and loamy, undulating
10E	Marlette loam, 18 to 35 percent slopes	42	Pits
11B	Capac sandy loam, 0 to 4 percent slopes	43	Sloan-Marlette association
12	Brookston and Colwood loams	44B	Riddles sandy loam, 1 to 6 percent slopes
13B	Oshkemo-Boyer loamy sands, 0 to 6 percent slopes	44C	Riddles sandy loam, 6 to 12 percent slopes
13C	Oshkemo-Boyer loamy sands, 6 to 12 percent slopes	44D	Riddles sandy loam, 12 to 18 percent slopes
13E	Oshkemo-Boyer loamy sands, 12 to 40 percent slopes	45B	Arkport loamy fine sand, 2 to 6 percent slopes
14B	Oakville fine sand, 0 to 6 percent slopes	45C	Arkport loamy fine sand, 6 to 12 percent slopes
14C	Oakville fine sand, 6 to 18 percent slopes	45D	Arkport loamy fine sand, 12 to 25 percent slopes
15B	Spinks loamy sand, 0 to 6 percent slopes	46A	Dixboro loamy fine sand, 0 to 3 percent slopes
15C	Spinks loamy sand, 6 to 12 percent slopes	47B	Fox-Riddles sandy loams, 1 to 6 percent slopes
15E	Spinks loamy sand, 12 to 35 percent slopes	47C	Fox-Riddles sandy loams, 6 to 12 percent slopes
17A	Wasopi sandy loam, 0 to 3 percent slopes	48	Gifford sandy loam
18B	Fox sandy loam, 1 to 6 percent slopes	49	Cohoctah fine sandy loam
18C	Fox sandy loam, 6 to 12 percent slopes	50B	Udipsamments, undulating
18D	Fox sandy loam, 12 to 25 percent slopes	50D	Udipsamments, rolling to steep
19	Sebewa loam	51B	Leoni gravelly sandy loam, 1 to 6 percent slopes
20B	Glynwood loam, 2 to 6 percent slopes	51C	Leoni gravelly sandy loam, 6 to 12 percent slopes
20C	Glynwood loam, 6 to 12 percent slopes	52A	Selfridge loamy sand, 0 to 3 percent slopes
23B	Sisson fine sandy loam, 1 to 6 percent slopes	53A	Tedrow loamy sand, 0 to 3 percent slopes
23C	Sisson fine sandy loam, 6 to 12 percent slopes	54A	Matherton sandy loam, 0 to 3 percent slopes
25B	Owosso sandy loam, 1 to 6 percent slopes	56A	Urban land-Blount-Lenawee complex, 0 to 3 percent slopes
25C	Owosso sandy loam, 6 to 12 percent slopes	59	Urban land
26	Sloan silt loam	60B	Urban land-Marlette complex, 0 to 8 percent slopes
27	Houghton and Adrian mucks	60C	Urban land-Marlette complex, 8 to 15 percent slopes
31B	Metea loamy sand, 0 to 6 percent slopes	60D	Urban land-Marlette complex, 15 to 25 percent slopes
31C	Metea loamy sand, 6 to 12 percent slopes	61A	Urban land-Capac complex, 0 to 3 percent slopes
32B	Blount loam, 0 to 4 percent slopes	62B	Urban land-Spinks complex, 0 to 8 percent slopes
33	Lenawee silty clay loam	62C	Urban land-Spinks complex, 8 to 15 percent slopes
34B	Kibbie fine sandy loam, 0 to 4 percent slopes	63A	Urban land-Thetford complex, 0 to 3 percent slopes
35A	Thetford loamy fine sand, 0 to 3 percent slopes	67B	Ormas loamy sand, 0 to 6 percent slopes
36A	Metamora sandy loam, 0 to 3 percent slopes	67C	Ormas loamy sand, 6 to 12 percent slopes
38	Napoleon muck	68	Cohoctah-Fox association
39	Granby loamy sand	69	Thomas muck



13 CHROMIUM CONCENTRATION (mg/kg)



**GERAGHTY
& MILLER, INC.**
Environmental Services



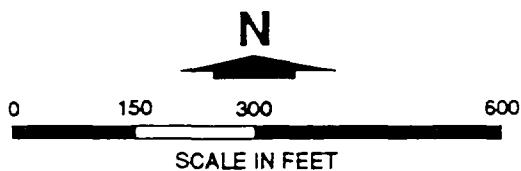
CONTOUR INTERVAL
 25
 50
 200
 400
 800
 1600

FIGURE 23
CHROMIUM ISOCONCENTRATION MAP
3 - 8 FEET

HIMILL MANUFACTURING
 HIGHLAND MICHIGAN

LEGEND

18 CHROMIUM CONCENTRATION (mg/kg)



HIMILL
MANUFACTURING

TARGET POND

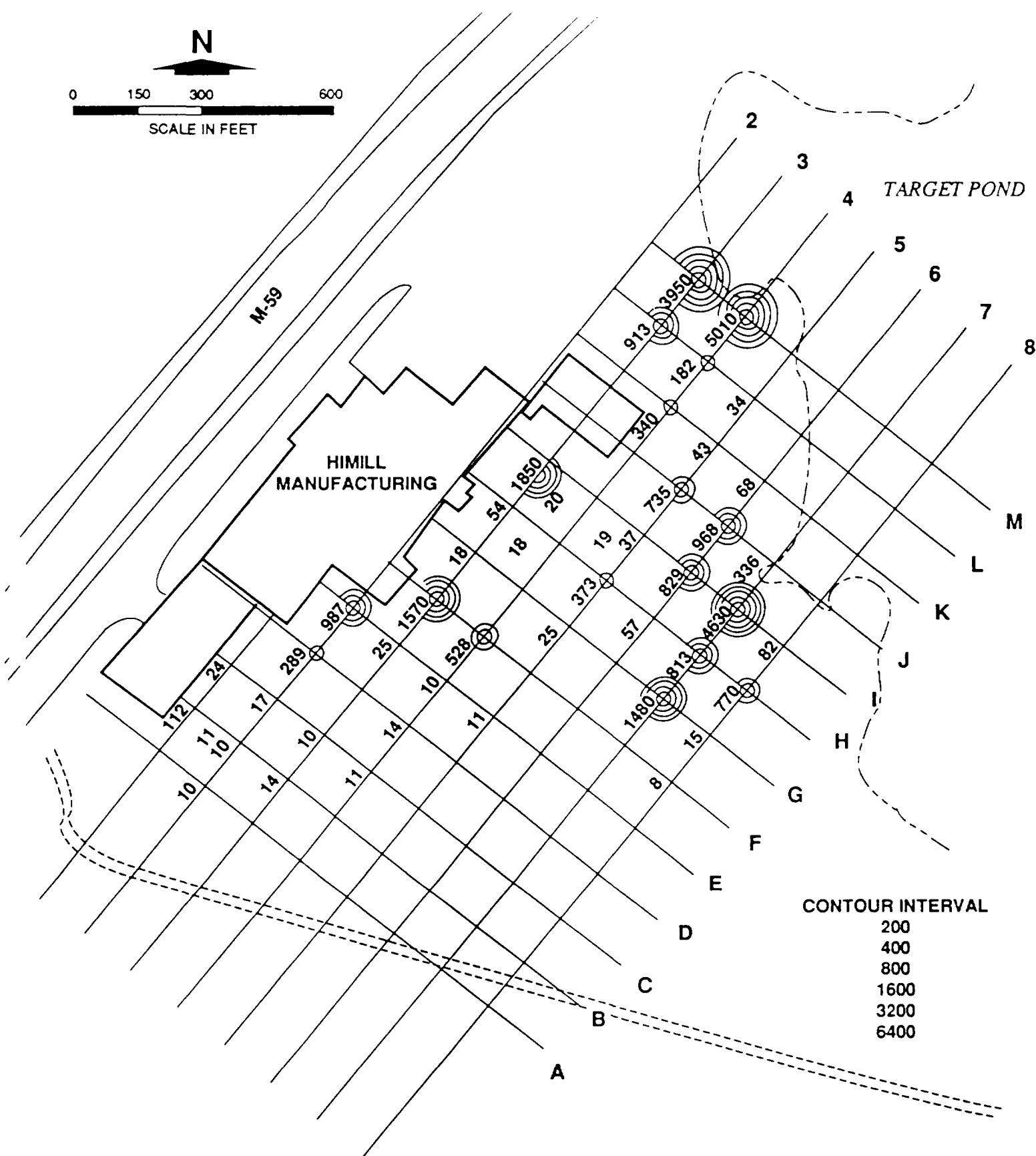
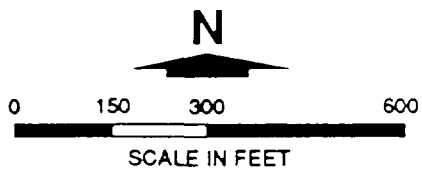
CONTOUR INTERVAL

25
50
200
400
800
1600

LEGEND

- 18 CHROMIUM CONCENTRATION (mg/kg)
- 118/28 2 SAMPLES COLLECTED AT GRID POINT
WITHIN VERTICAL RANGE INDICATED

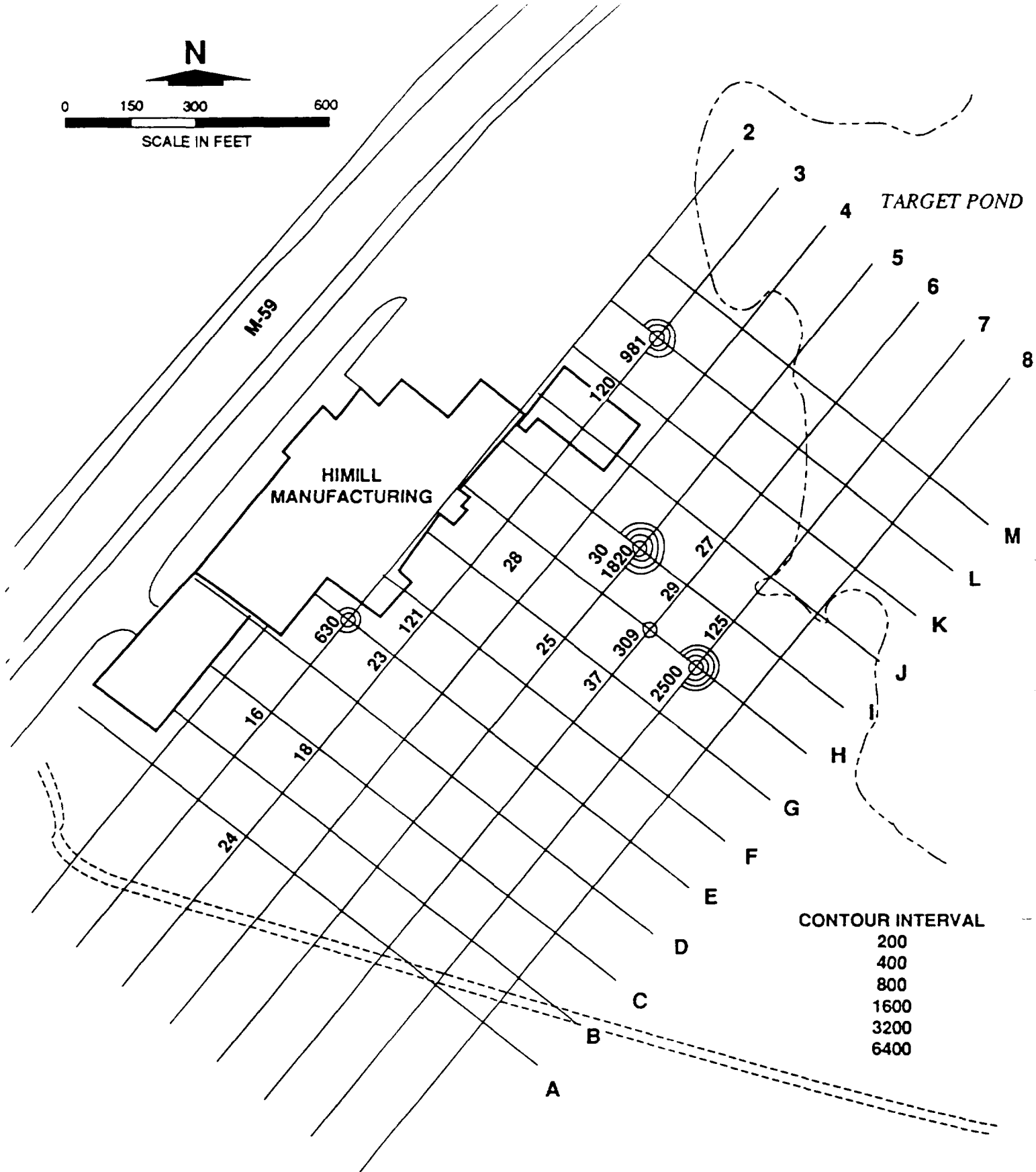
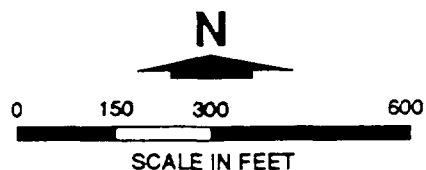
FIGURE 24
CHROMIUM
ISOCONCENTRATION MAP
8 - 16.5 FEET
HIMILL MANUFACTURING
HIGHLAND MICHIGAN



CONTOUR INTERVAL
 200
 400
 800
 1600
 3200
 6400

LEGEND

18 COPPER CONCENTRATION (mg/kg)

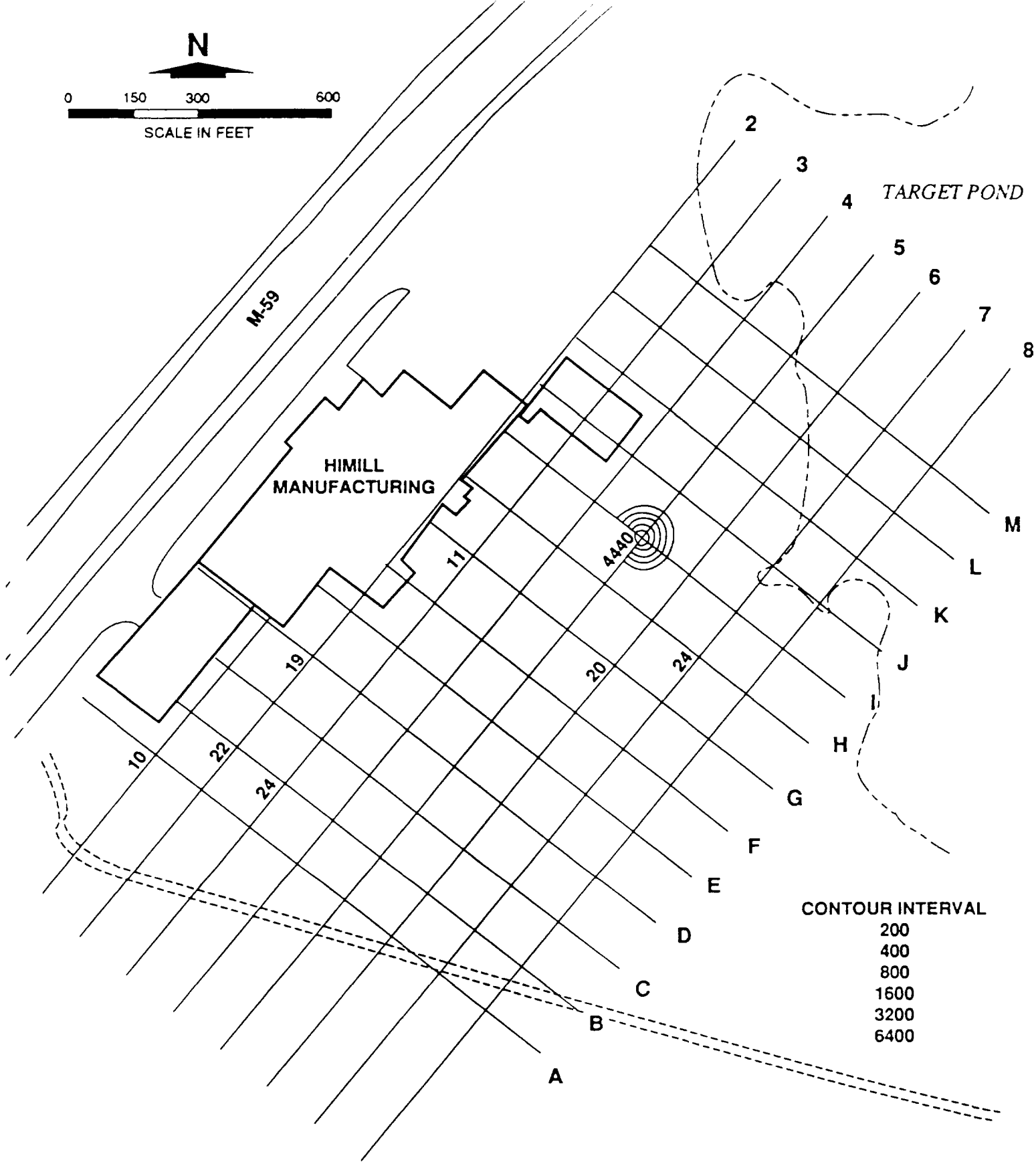
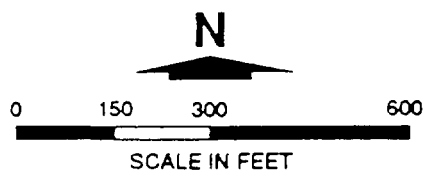


LEGEND

18 COPPER CONCENTRATION (mg/kg)

FIGURE 26
COPPER ISOCONCENTRATION MAP
1 - 3 FEET

HIMILL MANUFACTURING
HIGHLAND MICHIGAN



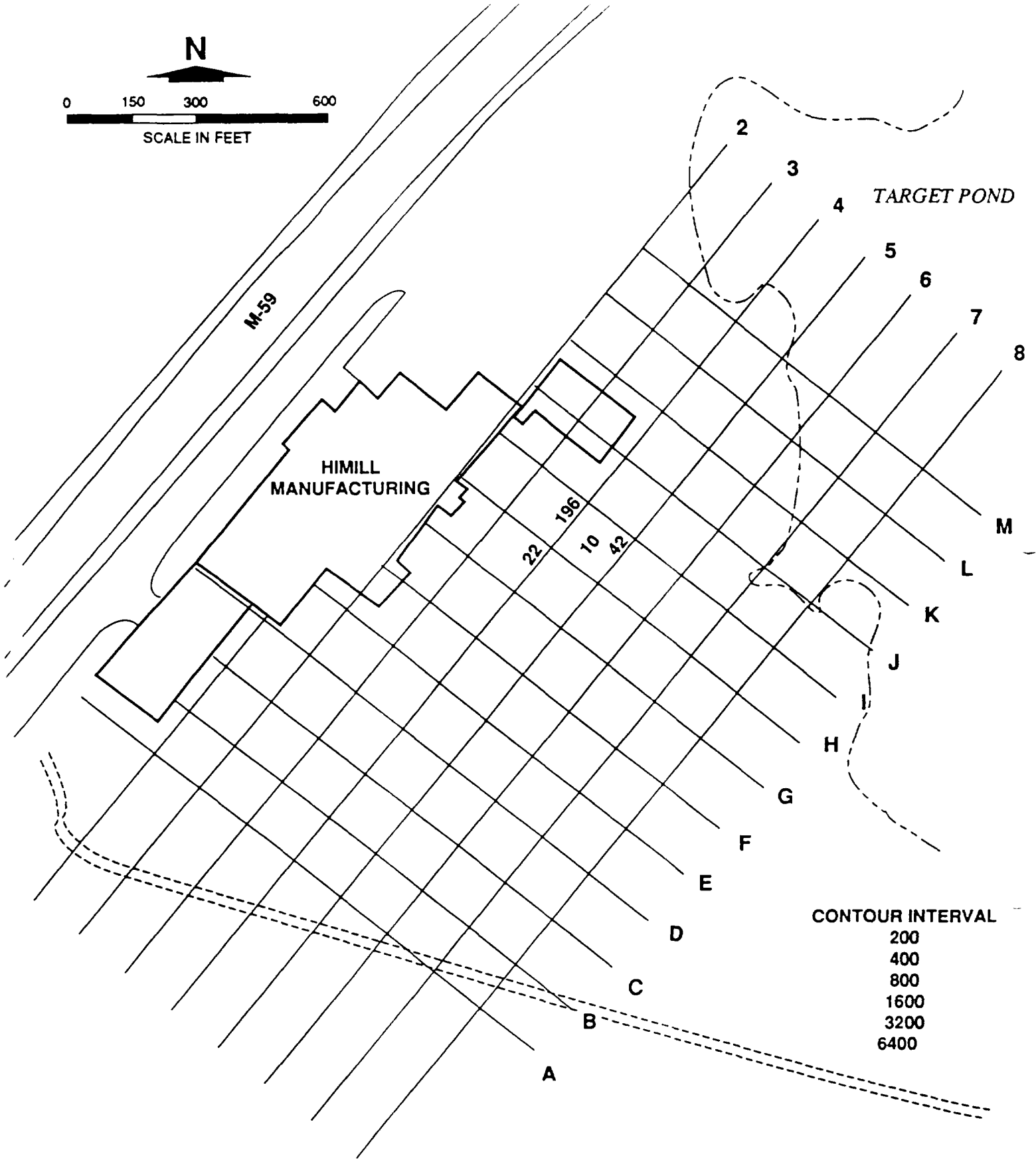
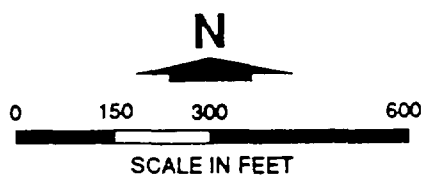
CONTOUR INTERVAL

200
400
800
1600
3200
6400

LEGEND

18 COPPER CONCENTRATION (mg/kg)

FIGURE 27
COPPER ISOCONCENTRATION MAP
3 - 8 FEET
HIMILL MANUFACTURING
HIGHLAND MICHIGAN



CONTOUR INTERVAL
200
400
800
1600
3200
6400

LEGEND

10 COPPER CONCENTRATION (mg/kg)

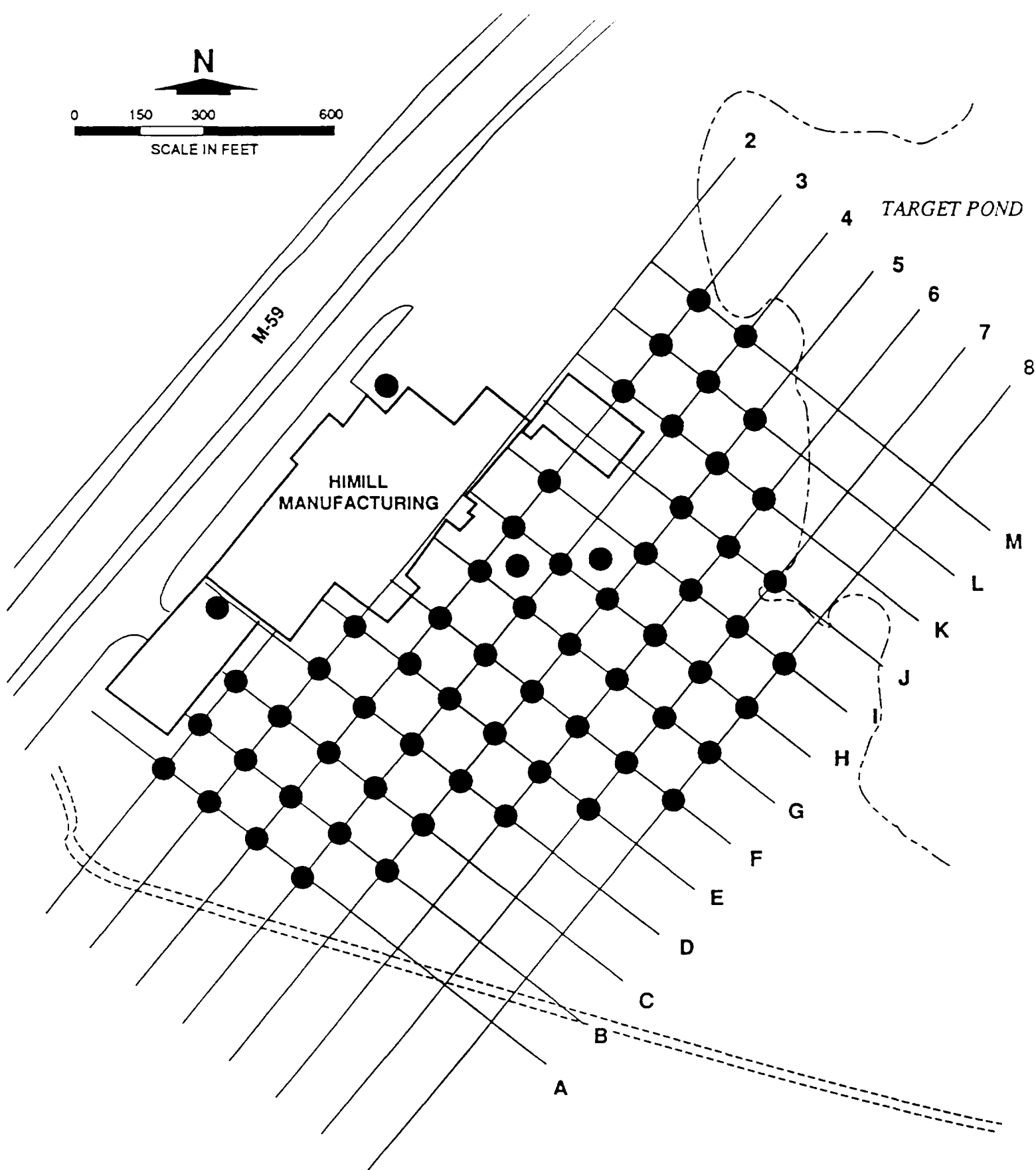
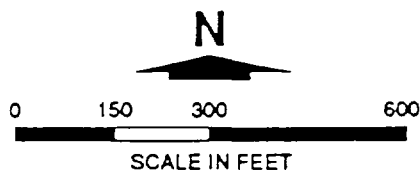


FIGURE 29
SOIL SAMPLES 0-1.0 FEET
60 FT x 60 FT GRID
SAMPLING LOCATION
HIMILL MANUFACTURING
HIGHLAND MICHIGAN

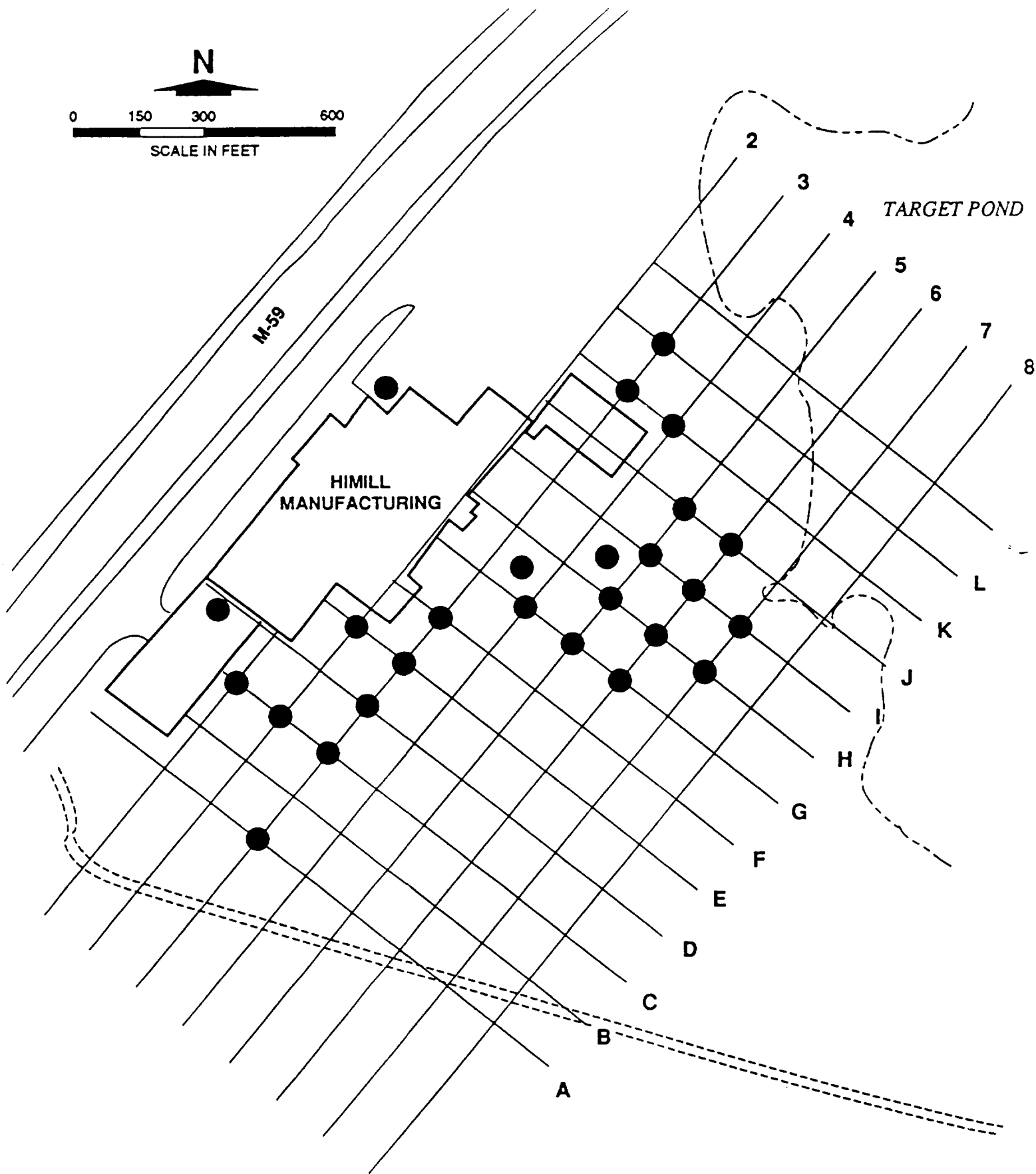
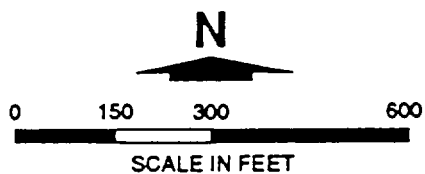


FIGURE 30
SOIL SAMPLES 1.0 - 3.0 FEET
60 FT x 60 FT GRID
SAMPLING LOCATION
HIMILL MANUFACTURING
HIGHLAND MICHIGAN

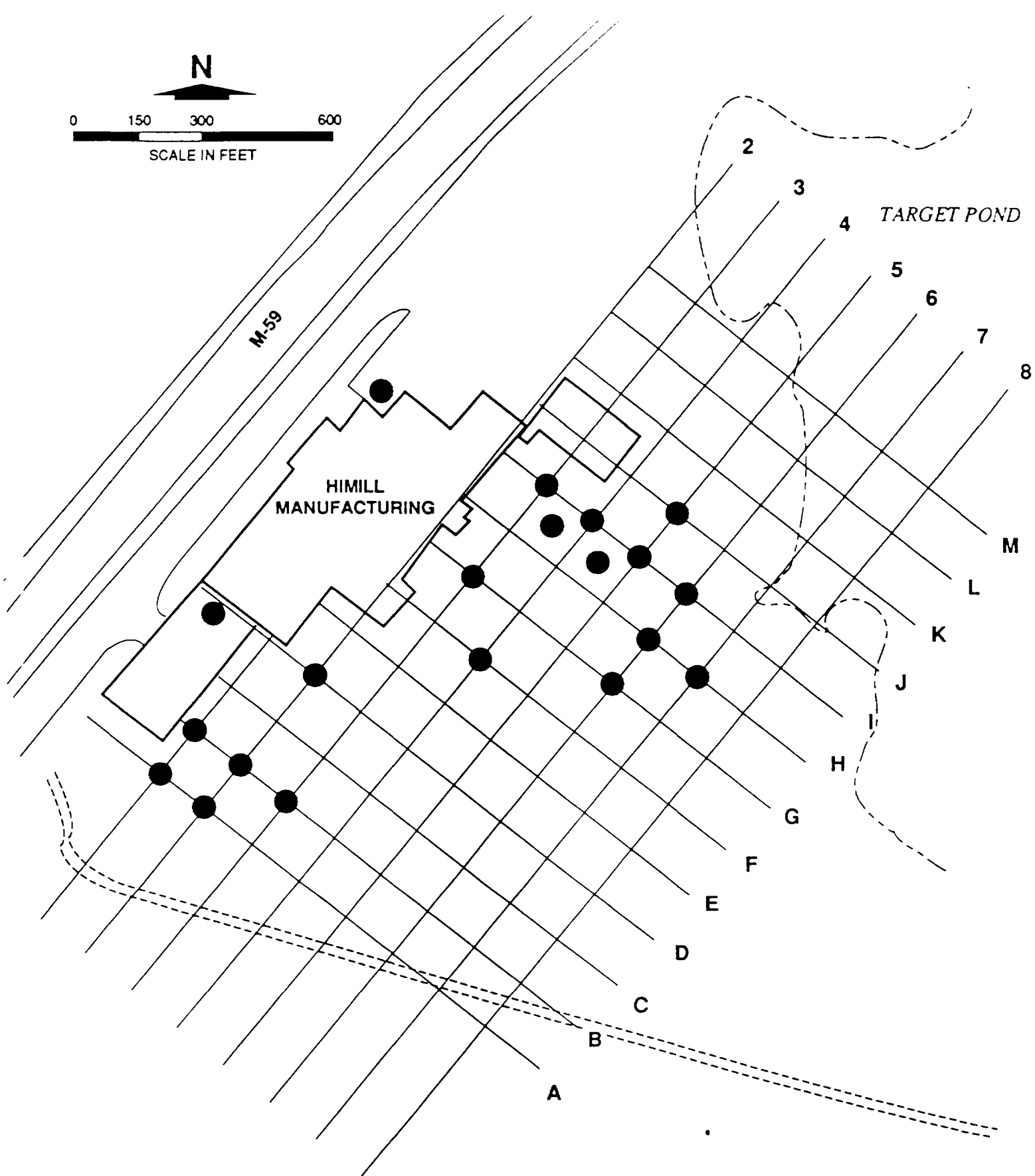


FIGURE 31
SOIL SAMPLES 3.0 - 8.0 FEET
60 FT x 60 FT GRID
SAMPLING LOCATION
HIMILL MANUFACTURING
HIGHLAND MICHIGAN

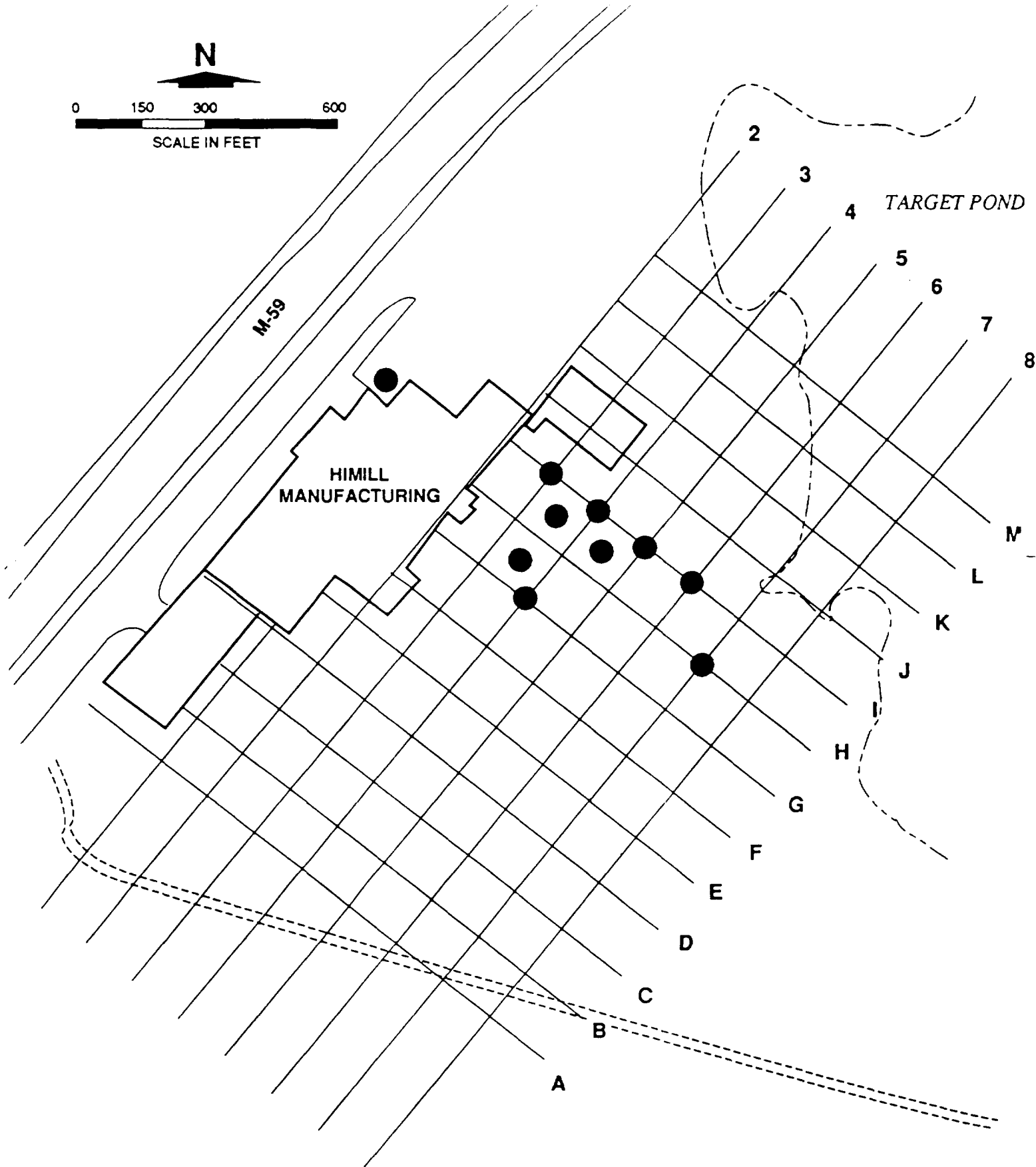
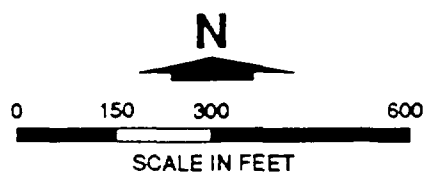
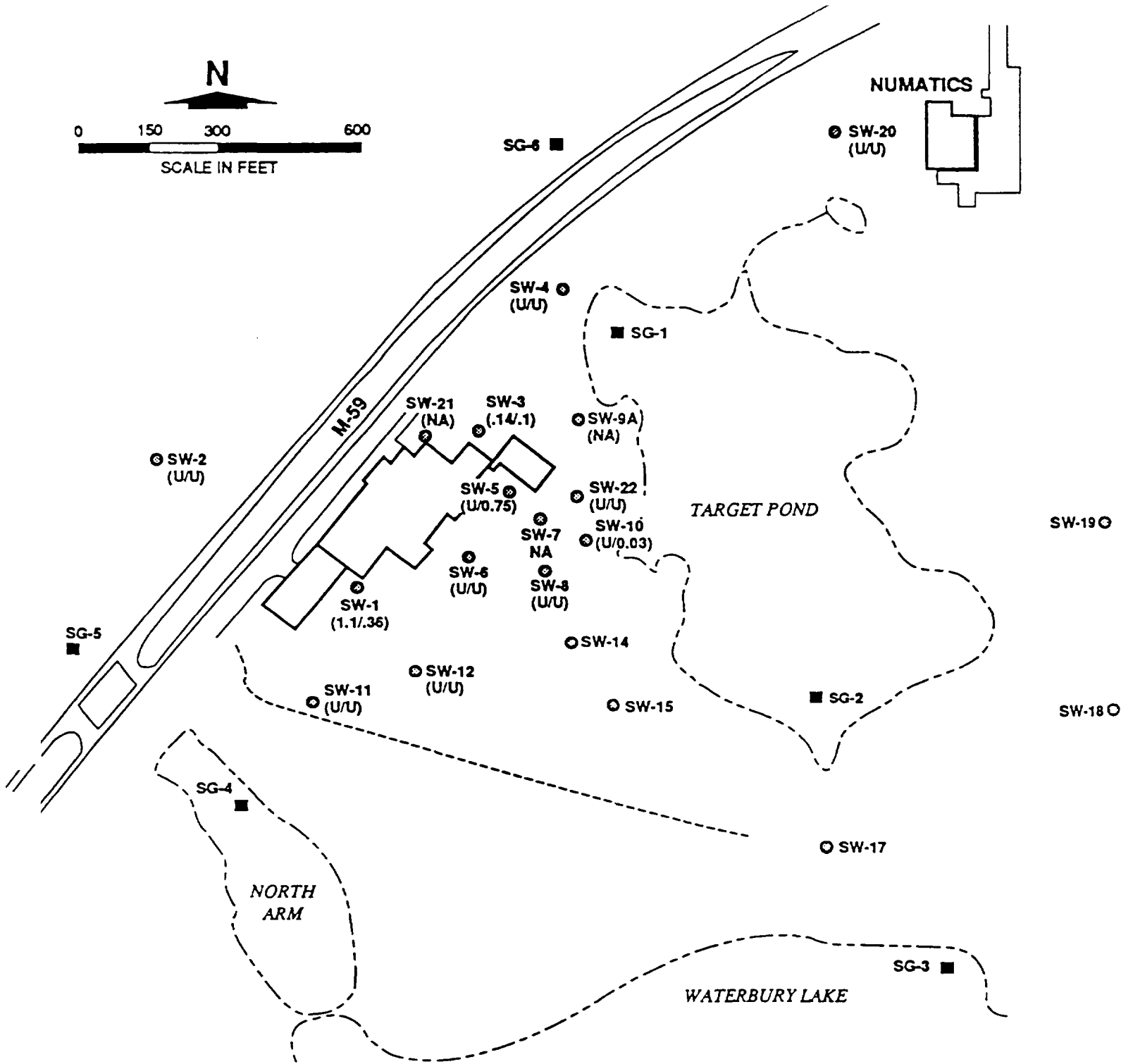


FIGURE 32
SOIL SAMPLES 8.0 - 16.5 FEET
60 FT x 60 FT GRID
SAMPLING LOCATION
HIMILL MANUFACTURING
HIGHLAND MICHIGAN



LEGEND

- SW-1 SHALLOW MONITORING WELL
- SG-1 STAFF GAUGE
- 1.1/.36 TCE CONCENTRATION/DCE CONCENTRATION
- NA NOT ANALYZED
- U UNDETECTED

FIGURE 33
TCE/DCE CONCENTRATIONS
MARCH 14 & 23, 1990
SHALLOW MONITORING WELLS
HIMILL MANUFACTURING
HIGHLAND MICHIGAN

TABLES

TABLE 1. GROUND-WATER MEASUREMENTS, HI-MILL MANUFACTURING, HIGHLAND, MICHIGAN.

Monitoring Well Number	Ground Surface Elevation	Well Stick Up	Top of Casing (TOC) Elevation	Well Screen Length	Total Sounded Depth From TOC	Approximate Screened Interval Eleva.	4/12/90 Static Water Level	5/11/90 Static Water Level	6/08/90 Static Water Level	10/31/90 Static Water Level	4/12/90 Ground Water Elevation	5/11/90 Ground Water Elevation	6/08/90 Ground Water Elevation	10/31/90 Ground Water Elevation
SW 1 ?	1010.06	3.11	1013.17	5	20.09	993 - 998	8.72	9.11	9.18	10.67	1004.45	1004.06	1003.99	1002.50
SW 2 ?	1015.40	2.64	1018.04	5	31.25	987 - 992	19.60	18.62	17.99	20.83	998.44	999.42	1000.05	997.21
SW 3	1009.33	3.10	1012.43	5	10.63	1002 - 1007	4.41	4.96	4.71	5.26	1008.02	1007.47	1007.72	1007.17
SW 4A	1007.24	2.94	1010.18	5	15.58	995 - 1000	3.64	4.21	4.41	4.46	1006.54	1005.97	1005.77	1005.72
SW 5	1008.33	3.62	1011.95	5	10.26	1002 - 1007	4.00	4.57	7.82	4.64	1007.95	1007.38	1004.13	1007.31
SW 68	1008.38	3.25	1011.63	5	13.88	998 - 1003	3.37	4.00	3.94	4.21	1008.26	1007.63	1007.69	1007.42
SW 7	1007.48	2.88	1010.36	5	17.94	992 - 997	4.12	4.31	4.62	4.71	1006.24	1006.05	1005.74	1005.65
SW 8	1007.90	2.95	1010.85	5	13.12	998 - 1003	3.70	4.85	5.22	5.05	1007.15	1006.00	1005.63	1005.80
SW 9	1007.12	2.98	1010.10	5	23.21	987 - 992	4.42	4.72	4.84	4.76	1005.68	1005.38	1005.26	1005.34
SW 9A ?	1006.86	3.32	1010.18	5	10.33	1000 - 1005	---	----	4.84	5.36	----	----	1005.34	1004.82
SW 10	1006.34	4.16	1010.50	3	8.98	1002 - 1005	4.48	5.02	4.80	5.17	1006.02	1005.48	1005.70	1005.33
SW 11	1010.01	3.03	1013.04	5	23.68	989 - 994	10.00	10.37	10.71	12.81	1003.04	1002.67	1002.33	1000.23
SW 12	1010.11	3.03	1013.14	5	13.10	1000 - 1005	3.16	3.71	4.07	4.29	1009.98	1009.43	1009.07	1008.85
SW 14	1006.45	3.31	1009.76	5	19.44	990 - 995	5.18	5.31	5.77	5.66	1004.58	1004.45	1003.99	1004.10
SW 15	1007.79	3.14	1010.93	5	15.11	996 - 1001	3.62	4.31	6.65	4.68	1007.31	1006.62	1004.28	1006.25
SW 17	1009.74	3.09	1012.83	5	41.85	971 - 976	12.74	12.85	12.78	13.49	1000.09	999.98	1000.05	999.34
SW 18	1005.67	2.91	1008.58	5	17.04	992 - 997	6.28	6.41	6.43	7.17	1002.30	1002.17	1002.15	1001.41
SW 19	1012.71	2.90	1015.61	5	33.05	983 - 988	11.94	11.89	11.86	12.95	1003.67	1003.72	1003.75	1002.66
SW 20	1008.29	1.47	1009.76	5	8.52	1001 - 1006	2.27	2.96	2.26	3.69	1007.49	1006.80	1007.50	1006.07
SW 21	1009.53	3.40	1012.93	5	9.89	1003 - 1008	5.39	NM	DAMAGED	5.36	1007.54	1012.93	----	1007.57
SW 22	1006.79	3.46	1010.25	3	8.88	1001 - 1004	4.27	4.62	4.72	4.77	1005.98	1005.63	1005.53	1005.48
IW 1	1014.71	2.31	1017.02	5	49.63	967 - 972	20.45	20.42	20.40	21.24	996.57	996.60	996.62	995.78
IW 2	1011.56	3.00	1014.56	5	49.32	965 - 970	16.49	16.47	16.34	17.30	998.07	998.09	998.22	997.26
IW 3	1008.91	2.99	1011.90	5	49.75	962 - 967	13.38	13.37	13.22	14.22	998.52	998.53	998.68	997.68
IW 4A	1007.04	3.02	1010.06	5	57.33	953 - 958	11.19	11.24	11.16	12.06	998.87	998.82	998.90	998.00
IW 5	1006.24	3.15	1009.39	5	38.53	971 - 976	10.40	10.41	10.36	11.19	998.99	998.98	999.03	998.20
DW 1 ?	1011.62	3.00	1014.62	5	83.89	931 - 936	17.37	17.26	17.17	18.10	997.25	997.36	997.45	996.52
DW 2	1008.91	3.08	1011.99	5	89.69	922 - 927	14.09	14.02	13.96	14.83	997.90	997.97	998.03	997.16
DW 3	1006.31	3.10	1009.41	5	74.12	935 - 940	12.02	11.90	11.84	13.73	997.39	997.51	997.57	995.68
EW 1	1008.05	---	1008.05	3	7.00	1001 - 1004	1.32	2.12	1.28	2.28	1006.73	1005.93	1006.77	1005.77
EW 2	1007.33	---	1007.33	3	7.00	1000 - 1003	1.40	1.74	1.49	1.85	1005.93	1005.59	1005.84	1005.48
EW 3	1010.82	---	1010.82	3	7.00	1004 - 1007	NM	5.14	---	5.30	----	1005.68	----	1005.52
EW 4	1009.94	---	1009.94	3	7.00	1003 - 1006	3.80	4.24	4.16	4.34	1006.14	1005.70	1005.78	1005.60
SG 1	-----	---	1007.76	---	---	-----	3.94	3.70	3.63	---	1005.70	1005.46	1004.36	-----
SG 2	-----	---	1005.97	---	---	-----	6.27	6.00	5.96	---	1005.74	1005.47	1005.43	-----
SG 3	-----	---	999.31	---	---	-----	6.17	6.15	6.26	---	999.48	999.46	999.57	-----
SG 4	-----	---	999.97	---	---	-----	6.36	6.06	5.92	---	1000.33	1000.03	999.89	-----
SG 5	-----	---	1006.67	---	---	-----	3.30	3.28	3.32	---	1003.97	1003.95	1003.99	-----
SG 6	-----	---	1006.85	---	---	-----	4.71	4.40	4.36	---	1005.56	1005.25	1005.21	-----

* - Gauge elevations recorded from the 6 ft. mark except SG-2 (recorded from the 6.5 mark)

** - Static Water Level Measurements Made From TOC Elevations.

TABLE 2A. SOIL ANALYTICAL ANALYSIS SUMMARY, HI-MILL MANUFACTURING
HIGHLAND, MICHIGAN

SAMPLE ID	SHORT LIST METALS	TAL INORGANIC	TCL VOA	TCL ORGANIC	TCL BNA	TCL PEST/ PCBs
A1-0	X					
A1-1	X					
A2-0	X					
A2-1	X					
A3-0	X					
A3-1	X					
B1-0	X					
B1-0-D	X					
B1-1	X					
B2-0	X					
B2-1	X					
B3-0	X					
B3-1	X					
C1-0	X					
C1-1	X					
C2-0	X					
C2-1	X					
C3-0	X					
C3-0-D	X					
C3-1	X					
D2-0	X					
D2-1	X					
D3-0	X					
D3-1	X					
D4-0	X					
D4-1	X					
E2-0	X					
E2-1	X					
E3-0	X					
E3-1	X					
F1-0						
F1-1						
F3-0	X					
F3-0-D	X					
F3-1	X					
F4-0	X					
F4-1	X					
G3-0	X					
G3-1	X					
G5-0	X					
G5-1	X					
H3-0	X					
H3-1	X					
H3/13-0	X					
H3/13-1	X					
H4-0	X					
H4-1	X					
K2-0	X					
K2-1	X					
K3-0	X					

TABLE 2A. SOIL ANALYTICAL ANALYSIS SUMMARY, HI-MILL MANUFACTURING
HIGHLAND, MICHIGAN.

SAMPLE ID	SHORT LIST METALS	TAL INORGANIC	TCL VOA	TCL ORGANIC	TCL BNA	TCL PEST/ PCBs
K3-1	X					
K4-0	X					
K4-0-D	X					
K4-1	X					
L3-0	X					
L3-1	X					
J5-0	X					
J5-1	X					
J5-2	X					
J5-3	X					
I6-0	X					
I6-0-D	X					
I6-1	X					
I6-2		X				
I6-3	X					
H7-0	X					
H7-1	X					
H7-2	X					
H7-3	X					
J6-0	X					
J6-1	X					
J6-2	X					
J6-3	X					
I7-0	X					
I7-1	X					
I7-2		X				
I7-3	X					
G3/H4-0	X					
G3/H4-1		X				
G3/H4-2	X					
G3-H4-3	X					
G4-0	X					
GA-0-D	X					
G4-1	X					
G4-2		X		X		
G4-3	X					
H4/I5-0	X					
H4/I5-1	X					
H4/I5-2		X				
H4/I5-2-D		X				
H4/I5-3	X					
G6-0	X					
G6-1	X					
G6-2	X					
G6-3	X					
H6-0	X					
H6-0-D	X					
H6-1	X					
H6-2	X					
H6-3	X					

TABLE 2A. SOIL ANALYTICAL ANALYSIS SUMMARY, HI-MILL MANUFACTURING
HIGHLAND, MICHIGAN.

SAMPLE ID	SHORT LIST METALS	TAL INORGANIC	TCL VOA	TCL ORGANIC	TCL BNA	TCL PEST/ PCBs
I5-0	X					
I5-1	X					
I5-2	X					
I5-3	X					
H3/I4-1		X				
H3/I4-2	X					
H3/I4-3	X					
I4-1	X					
I4-1-D	X					
I4-2		X		X		
I4-3	X					
I3-1	X					
I3-2		X				
I3-3	X					
RS01-0	X		X			
RS01-1	X		X			
RS01-2	X		X			
RS01-2-D			X			
RS01-3	X		X			
RS12-0	X		X			
RS12-1	X		X			
RS12-2	X		X			
RS12-2-D	X					
RS12-3	X		X			
RS23-0	X		X			
RS23-1	X		X			
RS23-2	X		X			
RS23-3	X		X			
RS34-0	X		X			
RS34-0-D			X			
RS34-1	X		X			
RS34-2	X		X			
RS34-3	X		X			
ST01-0	X		X			
ST01-0-D	X					
ST01-1	X		X			
ST01-2	X		X			
ST01-3	X		X			
ST12-0	X		X			
ST12-1	X		X			
ST12-2	X		X			
ST12-3	X		X			
ST12-3-D			X			
ST23-0	X		X			
ST23-1	X		X			
ST23-2	X		X			
ST23-2-D	X					
ST23-3	X		X			
ST34-0	X		X			
ST34-1	X		X			

TABLE 2A. SOIL ANALYTICAL ANALYSIS SUMMARY, HI-MILL MANUFACTURING
HIGHLAND, MICHIGAN.

SAMPLE ID	SHORT LIST METALS	TAL INORGANIC	TCL VOA	TCL ORGANIC	TCL BNA	TCL PEST/ PCBs
ST34-2	X		X			
ST34-3	X		X			
ZY01-0	X		X			
ZY01-1	X		X			
ZY01-1-D			X			
ZY01-2	X		X			
ZY01-3	X		X			
ZY12-0	X		X			
ZY12-0-D	X					
ZY12-1	X		X			
ZY12-2	X		X			
ZY12-3	X		X			
YX01-0	X		X			
YX01-1	X		X			
YX01-2	X		X			
YX01-3	X		X			
YX01-3-D			X			
YX12-0	X		X			
YX12-1	X		X			
YX12-2	X		X			
YX12-3	X		X			
XW01-0	X		X			
XW01-1	X		X			
XW01-2	X		X			
XW01-2-D	X					
XW01-3	X		X			
XW12-0	X		X			
XW12-1	X		X			
XW12-1-D			X			
XW12-2	X		X			
XW12-3	X		X			
WV01-0	X		X			
WV01-1	X		X			
WV01-2	X		X			
WV01-3	X		X			
WV12-0	X		X			
WV12-0-D	X		X			
WV12-1	X		X			
WV12-2	X		X			
WV12-3	X		X			
WV12-3-D	X		X			
A4-0	X					
B4-0	X					
B5-0	X					
C4-0		X				
C5-0	X					
D4-0	X					
D5-0	X					
D6-0	X					
E4-0	X					
E5-0		X				

TABLE 2A. SOIL ANALYTICAL ANALYSIS SUMMARY, HI-MILL MANUFACTURING
HIGHLAND, MICHIGAN.

SAMPLE ID	SHORT LIST METALS	TAL INORGANIC	TCL VOA	TCL ORGANIC	TCL BNA	TCL PEST/ PCBs
E6-0	X					
E7-0	X					
F5-0	X					
F6-0	X					
F7-0	X					
F7-0-D	X					
F8-0	X					
G7-0		X				
G8-0	X					
H8-0	X					
I8-0	X					
J7-0	X					
K5-0	X					
K6-0	X					
L2-0	X					
L4-0		X				
L5-0	X					
L5-0-D	X					
BG1-0						
BG1-1		X		X		
BG2-0		X		X	X	X
BG2-1		X		X		
BG3-0		X		X		
BG3-1		X		X		
BG4-0		X		X		
BG4-1		X		X		
BG5-0		X		X	X	X
BG5-1						
OG-1		X				
OG-2		X				
OG-3		X				
OG-4		X				

TABLE 2B. GROUND-WATER MONITORING WELL ANALYTICAL SUMMARY
HI-MILL MANUFACTURING, HIGHLAND, MICHIGAN.

WELL	METALS	INORGANICS	VOLATILES	B/N/A	NITROGEN
SW-1	X		X		X
SW-2	X	X	X	X	X
SW-3	X		X		X
SW-4	X		X		X
SW-5	X	X	X	X	X
SW-6	X		X		X
SW-7	X				X
SW-8	X	X	X	X	X
SW-9					
SW-10	X		X		X
SW-11	X		X		X
SW-12	X		X		X
SW-13	N/A				
SW-14	X				X
SW-15	X				X
SW-16					
SW-17	X				X
SW-18	X				X
SW-19	X				X
SW-20	X		X		X
SW-21	X				X
SW-22	X	X	X		X
IW-1	X	X	X	N/A	
IW-2	X		X		
IW-3	X	X	X		
IW-4	X		X		
IW-5	X	X	X		
DW-1	X		X		
DW-2	X		X		
DW-3	X		X		
EW-1	X				X
EW-2	X				X
EW-3					
EW-4	X				X
EW-5					
EW-6	X				X

TABLE 2C. SURFACE WATER SAMPLING ANALYTICAL SUMMARY, HI-MILL MANUFACTURING
HIGHLAND, MICHIGAN

WELL	METALS	INORGANICS	CHROMIUM	TOTAL CYANIDE	VOLATILES	B/N/A	NITROGEN
BP-1	X		X				X
BP-2	X		X				X
BP-3	X		X				X
BP-4		X	X				X
TP-1	X		X				
TP-2		X	X				
TP-2-FB			X				
TP-4	X		X				
TP-4-D			X				
TP-4-FB	X						
TP-7		X	X				X
TP-7-D		X					X
TP-7-FB							X
TP-9	X		X				
TP-10	X		X				X
TP-10-D	X		X				
TP-10-FB			X				
TP-11		X	X				
TP-11-D		X		X			
TP-11-FB		X					
WL-1	X		X				
WL-2	X		X				X

TABLE 2D. SURFACE WATER SEDIMENT SAMPLING ANALYTICAL SUMMARY, HI-MILL MANUFACTURING
HIGHLAND, MICHIGAN

WELL	METALS	INORGANICS	CHROMIUM	TOTAL CYANIDE	VOLATILES	B/N/A	NITROGEN
BP-1	X		X				
BP-2	X		X				
BP-3	X		X				
BP-4		X	X				
BP2							
TP-1	X		X				
TP-1-OD	X						
TP-2		X	X				
TP-3	X		X				
TP-4	X		X				
TP-4-1	X		X				
TP-5	X		X				
TP-6	X		X				
TP-6-1	X		X				
TP-7		X	X				
TP-7-1	X		X				
TP-7-1D	X		X				
TP-8	X		X				
TP-8-1		X	X				
TP-8-1D		X					
TP-9	X		X				
TP-10	X		X				
TP-11	X		X				
TP-11-1	X		X				
TP-11-1D			X				
TP-12	X		X				
WL-1	X		X				
WL-2	X		X				
WL-2-OD	X		X				

TABLE 2E. ANALYTICAL SUMMARY, HI-MILL MANUFACTURING, HIGHLAND, MICHIGAN.

EPA METHOD #	BASE NEUTRAL / ACID EXTRACTABLES		EPA METHOO #	VOLATILE ORGANIC COMPOUNDS		EPA METHOD #	INORGANICS
8270	Acenaphthene		8240	Acetone			GROUND WATER
8270	Acenaphthylene		8240	Benzene			
8270	Anthracene		8240	Bromodichloromethane	200.7		Aluminum
8270	Benzo(a)anthracene		8240	Bromoform	200.7		Antimony
8270	Benzo(b)fluoranthene		8240	Bromomethane	206.2		Arsenic
8270	Benzo(k)fluoranthene		8240	2-Butanone	200.7		Barium
8270	Benzo(ghi)perylene		8240	Carbon disulfide	200.7		Beryllium
8270	Benzo(a)pyrene		8240	Carbon tetrachloride	200.7		Cadmium
8270	Benzl alcohol		8240	Chlorobenzene	200.7		Calcium
8270	Bis(2-chloroethoxy)methane		8240	Chloroethane	200.7		Chromium
8270	Bis(2-chloroethyl)ether		8240	2-Chloroethyl vinyl ether	200.7		Cobalt
8270	Bis(2-chloroisopropyl)ether		8240	Chloroform	200.7		Copper
8270	Bis(2-ethylhexyl)phthalate		8240	Chloromethane	200.7		Iron
8270	4-Bromophenyl phenyl ether		8240	Dibromochloromethane	239.2		Lead
8270	Butyl benzl phthalate		8240	1,1-Dichloroethane	200.7		Magnesium
8270	4-Chloroaniline		8240	1,2-Dichloroethane	200.7		Manganese
8270	2-Chloronaphthalene		8240	1,1-Dichloroethene	245.5		Mercury
8270	4-Chlorophenyl phenyl ether		8240	1,2-Dichloroethene (Total)	200.7		Nickel
8270	Chrystene		8240	1,2-Dichloropropane	200.7		Potassium
8270	Dibenzo(a,h)anthracene		8240	cis-1,3-Dichloropropene	270.2		Selenium
8270	Dibenzofuran		8240	trans-1,3-Dichloropropene	200.7		Silver
8270	1,2-Dichlorobenzene		8240	Ethylbenzene	200.7		Sodium
8270	1,3-Dichlorobenzene		8240	2-Hexanone	279.2		Thallium
8270	1,4-Dichlorobenzene		8240	Methylene chloride	200.7		Vanadium
8270	3,3'-Dichlorobenzidine		8240	4-Methyl-2-pentanone	200.7		Zinc
8270	Diethyl phthalate		8240	Styrene	335.2		Cyanide
8270	Dimethyl phthalate		8240	1,1,2,2-Tetrachloroethane			
8270	2,4-Dinitrotoulene		8240	Tetrachloroethene			
8270	2,6-Dinitrotoluene		8240	Toluene			
8270	Di-n-butyl phthalate		8240	1,1,1-Trichloroethane			
8270	Di-n-octylphthalate		8240	1,1,2-Trichloroethane			
8270	Fluoranthene		8240	Trichloroethene			
8270	Fluorene		8240	Vinyl acetate			
8270	Hexachlorobenzene		8240	Vinyl chloride			
8270	Hexachlorobutadiene		8240	Xylene (total)			
8270	Hexachlorocyclopentadiene						
8270	Hexachloroethane						
8270	Indeno(1,2,3-c,d)pyrene						
8270	Isophorone						
8270	2-Methylnaphtalene						
8270	Naphtalene						
8270	2-Nitroaniline						
8270	3-Nitroaniline						
8270	4-Nitroaniline						
8270	Nitrobenzene						
8270	N-Nitroso-di-n-propylamine						
8270	N-Nitrosodiphenylamine						
8270	Phenanthrene						
8270	Pyrene						
8270	1,2,4-Trichlorobenzene						
	ACID EXTRACTABLES						
8270	Benozoic acid						
8270	4-Chloro-3-methylphenol						
8270	2-Chlorophenol						
8270	2,4-Dichlorophenol						
8270	2,4-Dimethylphenol						
8270	4,6-Dinitro-2-methylphenol						
8270	2,4-Dinitrophenol						
8270	2-Methylphenol						
8270	4-Methylphenol						
8270	2-Nitrophenol						
8270	4-Nitrophenol						
8270	Pentachlorophenol						
8270	Phenol						
8270	2,4,5-Trichlorophenol						
8270	2,4,6-Trichlorophenol						

TABLE 3. SUMMARY OF BACKGROUND CONCENTRATIONS AND STATISTICAL ANALYSIS
FOR SHORT LIST METALS IN SOILS
HI-MILL MANUFACTURING, HIGHLAND, MICHIGAN.

ANALYTE CONCENTRATIONS (mg/kg)

SAMPLE ID	ALUMINUM	CHROMIUM	COPPER	NICKEL	SILVER	ZINC
HMS-BG-1-0	4330.00	7.50	3.00	5.40	2.30U	24.40
HMS-BG-1-0D	4850.00	6.60	5.00	2.80U	2.30U	26.60
HMS-BG-2-0	16000.00	224.00	892.00	20.30	2.60U	100.00
HMS-BG-2-1	9980.00	15.00	17.10	8.80	2.10U	39.00
HMS-BG-3-0	4760.00	8.00	5.80	4.90	2.40U	27.80
HMS-BG-4-0	6710.00	12.60	2.50U	6.00	2.30U	20.90
HMS-BG-4-1	26400.00	45.20	7.50	50.20	2.30U	70.20
HMS-BG-5-0	3950.00	7.80	2.70U	6.00	2.4.0U	22.90
HMS-BG-5-1	3900.00	8.00	2.30U	2.50U	2.10U	22.49
HMS-BG-6-1	6330.00	9.50	6.40	3.80	2.10U	23.50

STATISTICAL ANALYSIS

(After Removing Samples BG-2-0, BG-2-1 and BG-4-1)

SAMPLE ID	ALUMINUM	CHROMIUM	COPPER	NICKEL	SILVER	ZINC
HMS-BG-1-0	4330.00	7.50	3.00	5.40	0.00	24.40
HMS-BG-1-0D	4850.00	6.60	5.00	2.80 U	2.30 U	26.60
HMS-BG-3-0	4760.00	8.00	5.80	4.90	0.00	27.80
HMS-BG-4-0	6710.00	12.60	2.50 U	6.00	2.30 U	20.90
HMS-BG-5-0	3950.00	7.80	0.00	6.00	0.00	22.90
HMS-BG-5-1	3900.00	8.00	2.30 U	0.00	2.10 U	22.49
HMS-BG-6-1	6330.00	9.50	6.40	3.80	0.00	23.50

MEAN	4975.71	8.57	3.57	4.13	0.96	24.08
STANDARD DEVIATION	1037.19	1.83	2.10	2.00	1.11	2.23
MEAN + 2 STD	7050.10	12.23	7.77	8.14	3.17	28.53

		RS01-0	RS01-2	RS01-2D	RS01-3	RS23-0	RS23-1	RS23-3	RS23-3 RE	RS34-0	RS34-2	RS34-3
Acetone	0.012 mg/kg	0.055 B	0.080 B	U	0.110 B	0.140 B	0.016 B	0.110 B	0.210 B	0.110 B	0.120B	0.150 B
Benzene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Bromodichloromethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Bromoform	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Bromomethane	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
2-Butanone	0.012 mg/kg	U	U	U	U	U	U	U	0.019 B	U	U	U
Carbon disulfide	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Carbon tetrachloride	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Chlorobenzene	0.006 mg/kg	U	U	U	U	U	0.014	U	U	U	U	U
Chloroethane	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
2-Chloroethyl vinyl ether	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Chloroform	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Chloromethane	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Dibromochloromethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,2-Dichloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,2-Dichloroethene (Total)	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,2-Dichloropropane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
cis-1,3-Dichloropropene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
trans-1,3-Dichloropropene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Ethylbenzene	0.006 mg/kg	U	U	U	U	U	0.002 J	U	U	U	U	U
2-Hexanone	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Methylene chloride	0.006 mg/kg	0.006 B	0.004 J,B	0.006 B	0.005 J,B	0.110 B	0.005 J,B	0.010 B	0.005 J	0.006 B	0.006 B	0.006 B
4-Methyl-2-pentanone	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Styrene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,1,2,2-Tetrachloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Tetrachloroethene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Toluene	0.006 mg/kg	0.005 B	U	0.004 J	0.007 J	0.098 B	0.007 B	0.012 B	0.004 J	U	0.004 J,B	0.005 J,B
1,1,1-Trichloroethane	0.006 mg/kg	U	U	U	U	0.002 J	U	0.002 J	U	0.140	0.110	U
1,1,2-Trichloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Trichloroethene	0.006 mg/kg	0.007	0.003 J	U	0.007	0.028	0.004 J	0.003 J	0.002 J	0.043	0.007	0.001 J
Vinyl acetate	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Vinyl chloride	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Xylene (total)	0.006 mg/kg	U	0.001 J	U	U	U	0.002	0.002 J	U	U	U	U
Aluminum		9730	9830		12200	9890 E	10900 E	13800 E		14500 E	15000 E	11300 E
Chromium		16.3	27.0		19.1	18.0 *	21.3 *	24.3 *		23.7 *	23.7 *	19.8 *
Copper		12.1	10.5		11.8	2.3	2.3	4.2		4.4	2.4	2.5
Nickel		9.8	8.4		18.3	13.2	18.9	24.4		20.7	27.7	20.3
Silver		2.1 N	2.2 N		2.3 N	2.0 N	2.1 N	2.3 N		2.2 N	2.2 N	2.2 N
Zinc		57.5	73.6		42.0	45.2	38.4	52.2		58.1	56.2	47.7

TABLE 4A. SOIL ANALYTICAL RESULTS, HI-MILL MANUFACTURING, HIGHLAND, MICHIGAN.

		ST01-0	ST01-3	ST01-3DL	ST12-0	ST12-3	ST-12-3D	ST23-0	ST23-2	ST23-3	ST34-0	ST34-2
Acetone	0.012 mg/kg	U	0.049 B	U	U	U	U	0.049 B	0.098 B	0.041 B	0.086	U
Benzene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Bromodichloromethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Bromoform	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Bromomethane	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
2-Butanone	0.012 mg/kg	U	U	0.009 J, B	U	U	U	U	U	U	0.012 B	U
Carbon disulfide	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Carbon tetrachloride	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Chlorobenzene	0.006 mg/kg	U	U	U	U	U	0.002 J	U	U	U	U	U
Chloroethane	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
2-Chloroethyl vinyl ether	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Chloroform	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Chloromethane	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Dibromochloromethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,2-Dichloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,2-Dichloroethene (Total)	0.006 mg/kg	U	0.036	U	U	0.013	U	U	U	0.041	U	U
1,2-Dichloropropane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
cis-1,3-Dichloropropene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
trans-1,3-Dichloropropene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Ethylbenzene	0.006 mg/kg	U	U	U	U	0.002 J	U	U	U	U	U	U
2-Hexanone	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Methylene chloride	0.006 mg/kg	0.005 J, B	0.005 JB	U	0.007 B	0.006 B	0.004 J, B	0.005 J, B	0.005 J, B	0.011 B	0.004 J	0.007 B
4-Methyl-2-pentanone	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Styrene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,1,2,2-Tetrachloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Tetrachloroethene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Toluene	0.006 mg/kg	0.003 J, B	0.004 J, B	0.010 J	0.005 J, B	0.007 B	0.004 J, B	0.004 J, B	0.005 J, B	0.006 B	0.004 J	0.006 B
1,1,1-Trichloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,1,2-Trichloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Trichloroethene	0.006 mg/kg	0.007	0.350	0.210	0.003 J	0.012	0.002 J	0.022	U	0.002 J	U	U
Vinyl acetate	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Vinyl chloride	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Xylene (total)	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Aluminum		13900	12900		11400	12400		8820	9930	13600	9970	17300
Chromium		27.1	16.7		62.4	17.8		14.7	14.5	17.3	16.1	21.8
Copper		13.5	14.8		15.9	15.3		13.5	15.9	17.7	51.8	42.7
Nickel		10.8	20.4		15.7	19.6		17.7	20.9	22.7	15.5	30.7
Silver		2.2 N	2.2 N		2.2 N	2.2 N		2.1 N	2.2 N	2.2 N	2.2 N	2.2 N
Zinc		65.9	40.3		77.7	39.8		58.1	38.5	45.5	100.00	61.7

TABLE 4A. SOIL ANALYTICAL RESULTS, HI-MILL MANUFACTURING, HIGHLAND, MICHIGAN.

		ST34-2 RE	ST34-3	ZY01-0	ZY01-1	ZY01-2	ZY01-3	ZY01-3 RE	XY01-2	XY01-3	XY01-3 RE	YX01-1
Acetone	0.012 mg/kg	0.140 B	U	U	U	U	U	U	U	U	U	U
Benzene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Bromodichloromethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Bromoform	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Bromomethane	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
2-Butanone	0.012 mg/kg	0.034 B	U	U	U	U	U	U	U	U	U	U
Carbon disulfide	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Carbon tetrachloride	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Chlorobenzene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Chloroethane	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
2-Chloroethyl vinyl ether	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Chloroform	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Chloromethane	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Dibromochloromethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,2-Dichloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,2-Dichloroethene (Total)	0.006 mg/kg	U	U	U	U	U	0.010	0.005 J	U	0.005 J	U	U
1,2-Dichloropropane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
cis-1,3-Dichloropropene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
trans-1,3-Dichloropropene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Ethylbenzene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
2-Hexanone	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Methylene chloride	0.006 mg/kg	0.003 J	0.010 B	0.009 B	0.011 B	0.009 B	0.024 B	0.010 B	0.011 B	0.017 B	0.006 B	0.009 B
4-Methyl-2-pentanone	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Styrene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,1,2,2-Tetrachloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Tetrachloroethene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Toluene	0.006 mg/kg	0.002 J	0.003 J	0.003 J	0.003 J	0.003 J	0.012	0.007	0.004 J	0.008	0.004 J	0.003 J
1,1,1-Trichloroethane	0.006 mg/kg	U	U	U	U	U	0.001 J	U	U	U	U	U
1,1,2-Trichloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Trichloroethene	0.006 mg/kg	U	U	U	U	U	0.003 J	0.003 J	U	0.002 J	0.001 J	U
Vinyl acetate	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Vinyl chloride	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Xylene (total)	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Aluminum		10500	3730	4580	6580	13600			5260	14500		3780
Chromium		17.9	5.6	7.6	12.9	19.2			8.5	21		5.9
Copper		12.7	12.7	10.9	17.9	20.2			7.6	17.7		8.4
Nickel		17.9	9.8	11.3	12.3	29			13.6	29.6		8.7
Silver		2.2 N	2 N	2 N	2.1 N	2.2 N			2.1 N	2.2 N		2
Zinc		39.1	31	40.3	24.3	51			17.6	49.7		40

TABLE 4A. SOIL ANALYTICAL RESULTS, HI-MILL MANUFACTURING, HIGHLAND, MICHIGAN.

		YX01-1D	XW01-1	XW01-2	WV01-0	WV01-1	WV01-2	WV01-2 DL	WV01-3	WV01-3 DL	WV01-3D	WV01-3D DL
Acetone	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Benzene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Bromodichloromethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Bromoform	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Bromomethane	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
2-Butanone	0.012 mg/kg	U	U	U	U	U	U	0.012 J,B	U	U	U	U
Carbon disulfide	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Carbon tetrachloride	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Chlorobenzene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Chloroethane	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
2-Chloroethyl vinyl ether	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Chloroform	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Chloromethane	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Dibromochloromethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,2-Dichloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,2-Dichloroethene (Total)	0.006 mg/kg	U	U	U	U	U	0.130	0.006 J	0.090 B	U	0.140	U
1,2-Dichloropropane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
cis-1,3-Dichloropropene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
trans-1,3-Dichloropropene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Ethylbenzene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
2-Hexanone	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Methylene chloride	0.006 mg/kg	0.009 B	0.005 J,B	0.005 J,B	0.005 B	0.005 B	0.007 B	0.006 J,B	0.015 B	1.900 J,B	0.013 B	1.300 J, B
4-Methyl-2-pentanone	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Styrene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,1,2,2-Tetrachloroethane	0.006 mg/kg	U	U	U	U	U	U	U	0.002 J	U	U	U
Tetrachloroethene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Toluene	0.006 mg/kg	0.003 J	0.001 J,B	U	U	0.001 J,B	0.002 J,B	U	0.015 B	U	0.006 B	U
1,1,1-Trichloroethane	0.006 mg/kg	U	U	U	U	U	U	U	0.002 J	U	U	U
1,1,2-Trichloroethane	0.006 mg/kg	U	U	U	U	U	U	U	0.002 J	U	U	U
Trichloroethene	0.006 mg/kg	U	U	U	U	U	0.240	0.100	5.700	57.000	6.400	45.000
Vinyl acetate	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Vinyl chloride	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Xylene (total)	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Aluminum			4240 E	6100 E	4950 E	4550 E	9410 E		13800 E		11700 E	
Chromium			17.6 *	12.3 *	74.5 *	7.3 *	16.9 *		24.4 *		21.3 *	
Copper			35.3	7.4	285	2.2	12.8		9		2.7	
Nickel			11.3	14.2	9.6	8.9	15.2		30		26.7	
Silver			2.1 N	2.1 N	2 N	2 N	2.1 N		2.2 N		2.4 N	
Zinc			47.4	25.5	45.1	28.7	28.9		55.8		52.1	

TABLE 4A. SOIL ANALYTICAL RESULTS, HI-MILL MANUFACTURING, HIGHLAND, MICHIGAN.

		YX12-0	YX12-1	YX12-12	YX12-3	YX12-3 RE	ZY12-1	ZY12-2	ZY12-3	XW12-2	XW12-3	ZY12-10
Acetone	0.012 mg/kg	U	U	U	U	0.065	U	U	U	0.013 B	0.054	U
Benzene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Bromodichloromethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Bromoform	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Bromomethane	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
2-Butanone	0.012 mg/kg	U	U	U	U	0.004 J	U	U	U	U	U	U
Carbon disulfide	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Carbon tetrachloride	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Chlorobenzene	0.006 mg/kg	U	U	0.003 J	U	U	U	U	U	U	U	U
Chloroethane	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
2-Chloroethyl vinyl ether	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Chloroform	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Chloromethane	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Dibromochloromethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,2-Dichloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,2-Dichloroethene (Total)	0.006 mg/kg	U	U	0.004 J	U	U	U	0.002 J	U	U	U	U
1,2-Dichloropropane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
cis-1,3-Dichloropropene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
trans-1,3-Dichloropropene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Ethylbenzene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
2-Hexanone	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Methylene chloride	0.006 mg/kg	0.006 B	0.006 B	0.006 B	0.011 B	0.012	0.006 B	0.006 B	0.011 B	0.006 B	0.006 B	0.006
4-Methyl-2-pentanone	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Styrene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,1,2,2-Tetrachloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Tetrachloroethene	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Toluene	0.006 mg/kg	0.003 J, B	0.003 J, B	0.004 J, B	0.011 B	0.015	0.003 JB	0.003 J, B	0.004 J	U	U	0.003
1,1,1-Trichloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
1,1,2-Trichloroethane	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Trichloroethene	0.006 mg/kg	0.002 J	0.002 J	0.022	0.003 J	0.08	0.041	0.008	0.018	U	U	0.028
Vinyl acetate	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Vinyl chloride	0.012 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Xylene (total)	0.006 mg/kg	U	U	U	U	U	U	U	U	U	U	U
Aluminum		2130 E	2780 E	18300 *	13000 E		3930	9240	14500	7760	14500	
Chromium		4.9 *	4.6 *	38.9	22.3 *		6.2	19.6	25.5	42	24.6	
Copper		8.6	2.3	135 EN*	5.7		6.9	162	7	130	13.9	
Nickel		7.1	9.4	23.6	28.9		9.6	19.9	30.6	12.4	28.2	
Silver		2.1 M	2.1 M	2.3 M	2.1 M		2.1 M	2.2 M	2.1 M	2.1 M	2.1 M	
Zinc		39.8	38.3	46.9	56.6		38.3	39.2	55.6	38.3	53.1	

VOLATILE ORGANIC COMPOUNDS	Detection Limit	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9A	SW-10	SW-11
Acetone	0.010 mg/L	0.160 B	U	0.046 B	U	0.027 B	0.006 J,B	N/A	U	N/A	0.002 J,B	U
Benzene	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
Bromodichloromethane	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
Bromoform	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
Bromomethane	0.010 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
2-Butanone	0.010 mg/L	U	U	0.010 J,B	0.015 B	U	0.001 J,B	N/A	U	N/A	0.004 J,B	U
Carbon disulfide	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
Carbon tetrachloride	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
Chlorobenzene	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
Chloroethane	0.010 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
2-Chloroethyl vinyl ether	0.010 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
Chloroform	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
Chloromethane	0.010 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
Dibromochloromethane	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
1,1-Dichloroethane	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
1,2-Dichloroethane	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
1,1-Dichloroethene	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
1,2-Dichloroethene (Total)	0.005 mg/L	0.360	U	0.100	U	0.075	U	N/A	U	N/A	0.030	U
1,2-Dichloropropane	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
cis-1,3-Dichloropropene	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
trans-1,3-Dichloropropene	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
Ethylbenzene	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
2-Hexanone	0.010 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
Methylcyclohexane	0.005 mg/L	U	U	0.026 B	0.004 J,B	0.009 B	0.009 B	N/A	0.007 B	N/A	0.006 B	0.005 B
4-Methyl-2-pentanone	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
Styrene	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
1,1,2,2-Tetrachloroethane	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
Tetrachloroethene	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
Toluene	0.005 mg/L	U	U	U	0.003 J	U	U	N/A	U	N/A	0.004 J,B	0.003 J,B
1,1,1-Trichloroethane	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
1,1,2-Trichloroethane	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
Trichloroethene	0.005 mg/L	1.100	U	0.140	U	U	U	N/A	U	N/A	U	U
Vinyl acetate	0.010 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
Vinyl chloride	0.010 mg/L	0.060 B	U	0.060 B	U	0.004 J	U	N/A	U	N/A	U	U
Xylene (total)	0.005 mg/L	U	U	U	U	U	U	N/A	U	N/A	U	U
SHORT LIST METALS		SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9A	SW-10	SW-11
Aluminum	85.00 ug/L	85.00 U	85.00 U	85.00 U	85.00 U	85.00 U	85.00 U	85.00 U	85.00 U	114.00 U	85.00 U	85.00 U
Chromium	7.00 ug/L	7.00 U	30.20 U,J	7.00 U	7.00 U	21.10 U,J	7.00 U	7.00 U	12.80 U,J	9.00 U	7.00 U	7.00 U
Copper	10.00 ug/L	10.00 U	10.00 U	10.00 U	10.00 U	10.00 U	10.00 U	93.30	10.00 U	16.90 B	33.80	10.00 U,N
Nickel	11.00 ug/L	17.90 B	11.00 U	11.00 U	29.80 B	11.00 U	11.00 U	34.30 B	11.00 U	19.00 U	15.60 B	129.00
Silver	9.00 ug/L	9.00 U,N	9.00 U	9.00 U	9.00 U,N	9.00 U	9.00 U,N	9.00 U,N	9.00 U	8.00 U	9.00 U,N	9.00 U,N
Zinc	5.00 ug/L	6.00 U	6.00 U	6.00 U	6.00 U	6.00 U	6.00 U	22.20	6.00 U	5.10 B	6.00 U	6.00 U
Chromium (+6)		NR	NR	NR	NR	NR	NR	NR	NR		NR	NR
Ammonia Nitrogen	50.00 ug/L	150 A	50 A	310 A	190	1000 A	50 U,A	2100 A	320 A		1200 A	50 U,A
Nitrate + Nitrite	50.00 ug/L	50 U,C	50 U,A	50 U,A	120	16000 A	50 A	1600 A	230 A		110 A	50 A
Percent Solids		NR	NR	NR	NR	NR	NR	NR	NR		NR	NR
pH	Standard Units	7.38	7.99	7.05	7.14	7.57	6.91	5.7	5.6	6.76	7.1	5
Temperature (C)	Degrees Celsius	7.8	7.8	5.5	7.2	9.4	8.9	8.3	8.3	6.5	4.4	12.8
Conductivity	uMHO's	960	380	970	2120	1750	2620	2610	2490	532	1340	780

J - Analyte present at level less than the detection limit

B - Analyte present in sample blank

U - Analyte undetected

NA - Not Analyzed

Volatile Organic Compounds	Detection Limit	SW-12	SW-13	SW-14	SW-15	SW-17	SW-18	SW-19	SW-20	SW-21	SW-22	IW-1
Acetone	0.010 mg/L	0.011 B	N/A	N/A	N/A	N/A	N/A	N/A	0.017 B	N/A	U	U
Benzene	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
Bromodichloromethane	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
Bromoform	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
Bromomethane	0.010 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
2-Butanone	0.010 mg/L	0.006 J,B	N/A	N/A	N/A	N/A	N/A	N/A	0.010 B	N/A	U	0.005 J,B
Carbon disulfide	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
Carbon tetrachloride	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
Chlorobenzene	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
Chloroethane	0.010 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
2-Chloroethyl vinyl ether	0.010 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
Chloroform	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
Chloromethane	0.010 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
Dibromochloromethane	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
1,1-Dichloroethane	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
1,2-Dichloroethane	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
1,1-Dichloroethene	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
1,2-Dichloroethene (Total)	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
1,2-Dichloropropane	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
cis-1,3-Dichloropropene	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
trans-1,3-Dichloropropene	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
Ethylbenzene	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
2-Hexanone	0.010 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
Methylcyclohexane	0.005 mg/L	0.002 J,B	N/A	N/A	N/A	N/A	N/A	N/A	0.005 B	N/A	0.020 J	0.002 J,B
4-Methyl-2-pentanone	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
Styrene	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
1,1,2,2-Tetrachloroethane	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
Tetrachloroethene	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
Toluene	0.005 mg/L	0.003 J,B	N/A	N/A	N/A	N/A	N/A	N/A	0.003 J,B	N/A	U	0.003 J,B
1,1,1-Trichloroethane	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
1,1,2-Trichloroethane	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
Trichloroethene	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
Vinyl acetate	0.010 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
Vinyl chloride	0.010 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
Xylene (total)	0.005 mg/L	U	N/A	N/A	N/A	N/A	N/A	N/A	U	N/A	U	U
		SW-12	SW-13	SW-14	SW-15	SW-17	SW-18	SW-19	SW-20	SW-21	SW-22	IW-1
METALS												
Aluminum	85.00 ug/L	85.00 U	N/A	85.00 U	85.00 U	85.00 U	85.00 U	85.00 U	648.00	85.00 U	208.00 U	85.00 U
Chromium	7.00 ug/L	7.00 U	N/A	7.00 U	45.80	7.00 U	7.40 B	7.00 U	9.20 B	7.00 U	9.00 U	20.70 U,J
Copper	10.00 ug/L	10.00 U	N/A	10.00 U	10.00 U,N	10.00 U	10.00 U	10.00 U,N	10.00 U,N	10.00 U	11.00 U	10.00 U
Nickel	11.00 ug/L	11.00 U	N/A	11.00 U	149.00	11.00 U	11.00 U	119.00	131.00	11.00 U	20.30 B	11.00 U
Silver	9.00 ug/L	9.00 U,N	N/A	9.00 U,N	9.00 U,N	9.00 U,N	9.00 U,N	9.00 U,N	14.60 N	9.00 U,N	8.00 U	9.00 U
Zinc	5.00 ug/L	6.00 U	N/A	6.00 U	6.00 U	6.00 U	6.00 U	7.20 B	22.10	6.00 U	5.00 U	6.00 U
Chromium (+6)		NR		NR	NR	NR	NR	NR		NR	NR	
Ammonia Nitrogen	50.00 ug/L	50 U,A		80 A	50 U,A	100 U,A	50 U,A	70		2200 A	NR A	
Nitrate + Nitrite	50.00 ug/L	50 U,A		50 U,A	460 A	290 A	190 A	840		50 U,A	150 A	
Percent Solids		NR		NR	NR	NR	NR	NR		NR	NR	
pH	Standard Units	7.4		5.18	5.5	8.48	6.33	5.82	4.8	7.22	7.82	7
Temperature (C)	Degrees Celsius	4.4		10.6	12.8	8.3	6.7	12.8	12.8	5	1.7	12.2
Conductivity	uMHO's	730		1260	480	600	390	560	1850	1520	3570	1020

J - Analyte present at level less than the detection limit

B - Analyte present in sample blank

U - Analyte undetected

NA - Not Analyzed

Volatile Organic Compounds	Detection Limit	IW-2	IW-3	IW-4	IW-5	DW-1	DW-2	DW-3	EW-1	EW-2	EW-4	EW-6
Acetone	0.010 mg/L	U	0.018 B	0.003 J,B	U	0.022 B	0.016 B	U	N/A	N/A	N/A	N/A
Benzene	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
Bromodichloromethane	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
Bromoform	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
Bromomethane	0.010 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
2-Butanone	0.010 mg/L	U	U	0.005 J,B	U	0.007 J	U	U	N/A	N/A	N/A	N/A
Carbon disulfide	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
Carbon tetrachloride	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
Chlorobenzene	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
Chloroethane	0.010 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
2-Chloroethyl vinyl ether	0.010 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
Chloroform	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
Chloromethane	0.010 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
Dibromochloromethane	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
1,1-Dichloroethane	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
1,2-Dichloroethane	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
1,1-Dichloroethene	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
1,2-Dichloroethene (Total)	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
1,2-Dichloropropane	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
cis-1,3-Dichloropropene	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
trans-1,3-Dichloropropene	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
Ethylbenzene	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
2-Hexanone	0.010 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
Methylene chloride	0.005 mg/L	0.008	0.010 B	0.008 B	0.017 B	0.014 B	0.045 B	0.007	N/A	N/A	N/A	N/A
4-Methyl-2-pentanone	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
Styrene	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
1,1,2,2-Tetrachloroethane	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
Tetrachloroethene	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
Yolene	0.005 mg/L	U	U	0.006 B	0.003 J	U	0.001 J,B	U	N/A	N/A	N/A	N/A
1,1,1-Trichloroethane	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
1,1,2-Trichloroethane	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
Trichloroethene	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
Vinyl acetate	0.010 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
Vinyl chloride	0.010 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
Xylene (total)	0.005 mg/L	U	U	U	U	U	U	U	N/A	N/A	N/A	N/A
		IW-2	IW-3	IW-4	IW-5	DW-1	DW-2	DW-3	EW-1	EW-2	EW-4	EW-6
METALS												
Aluminum	85.00 ug/L	114.00 U	85.00 U	85.00 U	114.00 U	85.00 U	85.00 U	114.00 U	114.00 U	114.00 U	114.00 U	85.00 U
Chromium	7.00 ug/L	9.00 U	16.00 U,J	7.00 U	9.00 U	7.00 U	7.00 U	9.00 U	9.00 U	9.00 U	9.00 U	7.00 U
Copper	10.00 ug/L	11.00 U	10.00 U	10.00 U	11.00 U	10.00 U	10.00 U	11.00 U	11.30 B	11.00 U	19.80 B	10.00 U
Nickel	11.00 ug/L	19.00 U	11.00 U	11.00 U	19.00 U	11.00 U	11.00 U	19.00 U	19.00 U	19.00 U	19.00 U	11.00 U
Silver	9.00 ug/L	8.00 U	9.00 U	9.00 U	8.00 U	9.00 U,N	9.00 U,N	8.00 U	8.00 U	8.00 U	8.00 U	9.00 U,N
Zinc	5.00 ug/L	5.00 U	6.00 U	6.00 U	5.00 U	6.00 U	7.70 B	5.00 U	8.00 B	5.00 U	5.00 U	6.00 U
Chromium (+6)									NR	NR	NR	NR
Ammonia Nitrogen	50.00 ug/L								120 A	50	1400	50
Nitrate + Nitrite	50.00 ug/L								50 U,A	50 U	NR	50
Percent Solids									NR			NR
pH	Standard Units	7.88	N/A	6.96	7.8	7.89	6.9	8.17	7.16	8.15	7.41	7.15
Temperature (C)	Degrees Celsius	5	9.4	8.3	8.9	9.4	10	9.4	5	3.3	3.3	3.9
Conductivity	uMHO's	368	650	670	414	400	730	391	898	1648	1174	521

J - Analyte present at level less than the detection limit

B - Analyte present in sample blank

U - Analyte undetected

NA - Not Analyzed

TABLE 4B. GROUNDWATER ANALYTICAL RESULTS FOR BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS, HI-MILL MANUFACTURING, HIGHLAND, MICHIGAN.

BASE NEUTRAL EXTRACTABLES	EPA METHOD #	Detection Limit	SW-2	SW-5	SW-8	1W-1
Acenaphthene	8270	0.010 mg/L	U	U	U	N/A
Acenaphthylene	8270	0.010 mg/L	U	U	U	N/A
Anthracene	8270	0.010 mg/L	U	U	U	N/A
Benzo(a)anthracene	8270	0.010 mg/L	U	U	U	N/A
Benzo(b)fluoranthene	8270	0.010 mg/L	U	U	U	N/A
Benzo(k)fluoranthene	8270	0.010 mg/L	U	U	U	N/A
Benzo(ghi)perylene	8270	0.010 mg/L	U	U	U	N/A
Benzo(a)pyrene	8270	0.010 mg/L	U	U	U	N/A
Benzl alcohol	8270	0.010 mg/L	U	U	U	N/A
Bis(2-chloroethoxy)methane	8270	0.010 mg/L	U	U	U	N/A
Bis(2-chloroethyl)ether	8270	0.010 mg/L	U	U	U	N/A
Bis(2-chloroisopropyl)ether	8270	0.010 mg/L	U	U	U	N/A
Bis(2-ethylhexyl)phthalate	8270	0.010 mg/L	U	U	U	N/A
4-Bromophenyl phenyl ether	8270	0.010 mg/L	U	U	U	N/A
Butyl benzl phthalate	8270	0.010 mg/L	U	U	U	N/A
4-Chloroaniline	8270	0.010 mg/L	U	U	U	N/A
2-Chloronaphthalene	8270	0.010 mg/L	U	U	U	N/A
4-Chlorophenyl phenyl ether	8270	0.010 mg/L	U	U	U	N/A
Chrysene	8270	0.010 mg/L	U	U	U	N/A
Dibenzo(a,h)anthracene	8270	0.010 mg/L	U	U	U	N/A
Dibenzofuran	8270	0.010 mg/L	U	U	U	N/A
1,2-Dichlorobenzene	8270	0.010 mg/L	U	U	U	N/A
1,3-Dichlorobenzene	8270	0.010 mg/L	U	U	U	N/A
1,4-Dichlorobenzene	8270	0.010 mg/L	U	U	U	N/A
3,3'-Dichlorobenzidine	8270	0.020 mg/L	U	U	U	N/A
Diethyl phthalate	8270	0.010 mg/L	U	U	U	N/A
Dimethyl phthalate	8270	0.010 mg/L	U	U	U	N/A
2,4-Dinitrotoulene	8270	0.010 mg/L	U	U	U	N/A
2,6-Dinitrotoluene	8270	0.010 mg/L	U	U	U	N/A
Di-n-butyl phthalate	8270	0.010 mg/L	0.008 J	U	U	N/A
Di-n-octylphthalate	8270	0.010 mg/L	U	U	U	N/A
Fluoranthene	8270	0.010 mg/L	U	U	U	N/A
Fluorene	8270	0.010 mg/L	U	U	U	N/A
Hexachlorobenzene	8270	0.010 mg/L	U	U	U	N/A
Hexachlorobutadiene	8270	0.010 mg/L	U	U	U	N/A
Hexachlorocyclopentadiene	8270	0.010 mg/L	U	U	U	N/A
Hexachloroethane	8270	0.010 mg/L	U	U	U	N/A
Indeno(1,2,3-c,d)pyrene	8270	0.010 mg/L	U	U	U	N/A
Isophorone	8270	0.010 mg/L	U	U	U	N/A
2-Methylnaphthalene	8270	0.010 mg/L	U	U	U	N/A
Naphthalene	8270	0.010 mg/L	U	U	U	N/A
2-Nitroaniline	8270	0.050 mg/L	U	U	U	N/A
3-Nitroaniline	8270	0.050 mg/L	U	U	U	N/A
4-Nitroaniline	8270	0.050 mg/L	U	U	U	N/A
Nitrobenzene	8270	0.010 mg/L	U	U	U	N/A
N-Nitrosodi-n-propylamine	8270	0.010 mg/L	U	U	U	N/A
N-Nitrosodiphenylamine	8270	0.010 mg/L	U	U	U	N/A
Phenanthrene	8270	0.010 mg/L	U	U	U	N/A
Pyrene	8270	0.010 mg/L	U	U	U	N/A
1,2,4-Trichlorobenzene	8270	0.010 mg/L	U	U	U	N/A
ACID EXTRACTABLES						
Benozic acid	8270	0.050 mg/L	U	U	U	N/A
4-Chloro-3-methylphenol	8270	0.010 mg/L	U	U	U	N/A
2-Chlorophenol	8270	0.010 mg/L	U	U	U	N/A
2,4-Dichlorophenol	8270	0.010 mg/L	U	U	U	N/A
2,4-Dimethylphenol	8270	0.010 mg/L	U	U	U	N/A
4,6-Dinitro-2-methylphenol	8270	0.050 mg/L	U	U	U	N/A
2,4-Dinitrophenol	8270	0.050 mg/L	U	U	U	N/A
2-Methylphenol	8270	0.010 mg/L	U	U	U	N/A
4-Methylphenol	8270	0.010 mg/L	U	U	U	N/A
2-Nitrophenol	8270	0.010 mg/L	U	U	U	N/A
4-Nitrophenol	8270	0.050 mg/L	U	U	U	N/A
Pentachlorophenol	8270	0.050 mg/L	U	U	U	N/A
Phenol	8270	0.010 mg/L	U	U	U	N/A
2,4,5-Trichlorophenol	8270	0.010 mg/L	U	U	U	N/A
2,4,6-Trichlorophenol	8270	0.010 mg/L	U	U	U	N/A

J - Analyte present at level less than the detection limit

U - Analyte not detected

TABLE 4C. SURFACE WATER ANALYTICAL RESULTS FOR, 3/1/90 - 3/2/90, SHORT LIST METALS, CHROMIUM (+6), AMMONIA NITROGEN, NITRATE & NITRITE NITROGEN, HI-MILL MANUFACTURING, HIGHLAND, MICHIGAN.

SHORT LIST METALS	BP-1	BP-2	BP-3	BP-4	TP-1	TP-2	TP-2-FB	TP-4	TP-4-FB
Aluminum	85.00 U	85.00 U	85.00 U	85.00 U	85.00 U	85.00		85.00 U	85.00 U
Chromium	7.00 U	7.00 U	7.00 U	9.3 B	13.90	7.00		7.00 U	7.00 U
Copper	19.5 B,N	10.00 U,N	10.00 U,N	10.00 U	10.00 U,N	10.00		10.00 U,N	10.00 U,N
Nickel	13.80 B	11.00 U	17.80 B	11.00 U	283.00	11.00		143.00	169.00
Silver	9.00 U,N	12.50 N	9.00 U,N	9.00 B	9.00 U,N	9.00		9.00 U,N	9.00 U,N
Zinc	11.80 B	6.00 U	6.00 U	12.40 B	13.10 B	6.00		6.00 U	6.00 U
Cyanide				10 U					
Chromium (+6)	10.00 U,C	10.00 U,C	10.00 U,C	10.00 U,C	10.00 U,C	10.00 U,C	10.00 U,C	10.00 U,C	
Ammonia Nitrogen	160.00 A,C	140.00 A,C	60.00 A,C	50.00 A,C	NR	NR	NR	NR	
Nitrate + Nitrite Nitrogen	180.00 A,C	100.00 A,C	100.00 A,C	70.00 A,C	NR	NR	NR	NR	
Percent Solids	NR	NR	NR	NR	NR	NR	NR	NR	
	TP-4-D	TP-7	TP-7-D	TP-7-FB	TP-9	TP-10	TP-10-D	TP-10-FB	TP-11
Aluminum		85.00 U	85.00 U		5360.00	85.00 U	85.00 U		85.00 U
Chromium		7.00 U	9.30 B		7.00 U	7.00 U	7.00 U		28.50
Copper		10.00 U	10.00 U		10.00 U,N	21.40 B,N	10.00 U,N		13.00 B
Nickel		11.00 U	11.00 U		302.00	281.00	247.00		11.00 U
Silver		9.10 U	9.00 U		11.40 N	9.00 U,N	9.00 U,N		9.00 U
Zinc		6.00 U	6.00 U		6.00 U	15.70 B	16.20 B		6.70 B
Cyanide		10 U							
Chromium (+6)	10.00 U,C	10 U,C	NR	NR	10.00 U,C	10.00 U,C	10.00 U,C	10.00 U,C	10.00 U,C
Ammonia Nitrogen	NR	NR	NR	50.00 U,C	NR	NR	NR	NR	NR
Nitrate + Nitrite Nitrogen	NR	50	50 U,A,C	1200.00 A,C	NR	NR	NR	NR	NR
Percent Solids	NR	NR	NR	NR	NR	NR	NR	NR	NR
	TP-11-D	TP-11-FB	WL-1	WL-2					
Aluminum		85.00 U	85.00 U	85.00 U					
Chromium		19.00	7.00 U	7.00 U					
Copper		10.00 U	10.00 U,N	10.00 U,N					
Nickel		11.00 U	122.00	143.00					
Silver		9.00 U	9.00 U,N	9.20 B,N					
Zinc		6.00 U	9.40 B	6.00 U					
Cyanide	10.00 U								
Chromium (+6)			10.00 U,C	10.00 U,C					
Ammonia Nitrogen			NR	NR					
Nitrate + Nitrite Nitrogen			NR	50.00 U,A,C					
Percent Solids			NR	NR					

U -

TABLE 4D. SURFACE WATER SEDIMENT ANALYTICAL RESULTS FOR, 2/20/90 - 2/22/90, SHORT LIST METALS, CHROMIUM (+6), AMMONIA NITROGEN, NITRATE & NITRITE NITROGEN, HI-MILL MANUFACTURING, HIGHLAND, MICHIGAN.

SHORT LIST METALS	BP-1	BP-2	BP-3	BP-4	TP-1	TP-1-D	TP-2	TP-3	TP-4-0
Aluminum	1090.00	946.00	3530.00	3610.00	14100.00	13800.00	33900.00	11800	28400.00
Chromium	22.90 B	29.80 U	20.30 U	37.1	21.90	18.60	43.20	17.3	145.00
Copper	30.3 U	42.60 U,N	34.80 B	28.20 U	42.20	52.60	36.90	2.8	429.00
Nickel	33.30 U	46.80 U	31.90 U	31.00 U	13.90 B	12.20	23.30	13.6	41.90
Silver	27.30 U,N	38.30 U,N	26.10 U,N	25.40 U	3.30 U,N	2.70 U,N	3.50 U	2.6 U,N	4.10 U,N
Zinc	18.20 U	25.50 U	71.60	122.00	86.80	56.00	42.70	48.7	104.00
Chromium (+6)	1.60 U,C	2.00 U,C	1.60 U,C	1.60	0.29 U,C		0.20 UNC	0.14	0.22 U,C
Ammonia Nitrogen	NR	NR	NR	NR	NR		NR	NR	NR
Nitrate + Nitrite Nitrogen	NR	NR	NR	NR	NR		NR	NR	NR
Percent Solids	6.20	4.90	6.10	6.10	34.40		50.80	69.90	45.40
	TP-4-1	TP-5	TP-6	TP-6-1	TP-7	TP-7-1	TP-8	TP-8-1	TP-8-1D
Aluminum	11800.00	12700.00	21500.00	15300.00	27800.00	16300.00	28600.00	15500.00	17300.00
Chromium	24.90	34.80	36.20	25.40	50.90	28.50	256.00	30.50	32.40
Copper	18.40	277.00 N	64.80	7.00	105.00	10.70	982.00	6.60	6.10
Nickel	28.20	17.50 B	21.10	27.80	27.00	27.20	33.10	30.60	32.40
Silver	2.20 U,N	4.90 U,N	3.00 U,N	2.20 U,N	3.20 U	2.30 U,N	3.10 U,N	2.20 U	2.20 U
Zinc	51.40	70.60	51.50	52.50	82.00	55.90	208.00	53.10	55.10
Chromium (+6)	0.12 U,C	0.27 U,C	0.17 U,C	0.12 U,C	0.19 U,N,C	0.13 U,N,C	0.18 U,N,C	0.12 U,N,C	
Ammonia Nitrogen	NR	NR	NR	NR	NR	NR	NR	NR	
Nitrate + Nitrite Nitrogen	NR	NR	NR	NR	NR	NR	NR	NR	
Percent Solids	82.30	37.20	58.20	83.10	53.40	79.00	55.70	81.20	
	TP-9	TP-10	TP-11	TP-11-1	TP-11-1D	TP-12	WL-2		
Aluminum	12500.00	167.00	21500.00	13800.00		16400.00	6770		
Chromium	31.20	36.40	974.00	32.00		33.60	7.3 U		
Copper	189.00 N	77.40 N	1860.00	15.10		238.00	10.4 U		
Nickel	7.30 B	23.80	22.80	22.70		15.40 U	28.1 B		
Silver	3.60 U,N	2.70 U,N	2.60 U,N	2.30 U,N		3.00 U,N	9.4 U,N		
Zinc	68.70	68.00	65.30	41.10		75.30	56.9		
Chromium (+6)	0.18 U,C	0.15 U,C	0.15 U,N,C	0.12 U,N,C	0.12 U,N,C	0.17 U,C	0.56 U,C		
Ammonia Nitrogen	NR	NR	NR	NR	NR	NR	NR		
Nitrate + Nitrite Nitrogen	NR	NR	NR	NR	NR	NR	NR		
Percent Solids	54.20	65.70	67.20	79.60	79.9	58.50	17.90		

U -
N -
C -

TABLE 4E: GROUND-WATER SAMPLES ANALYZED FOR TARGET ANALYTE LIST (TAL)
HI-MILL MANUFACTURING, HIGHLAND, MICHIGAN

	SW-2	SW-5	SW-8	SW-8D	SW-22	IW-1
Aluminum	85.0 U	85.0 U	85.0 U	85.0 U	208.0	85.0 U
Antimony	51.0 U	51.0 U	51.0 U	51.0 U	56.0 U	51.0 U
Arsenic	3.0 U,J,W	3.0 U,J,W	3.0 U,J,W	3.0 U,J,W	3.0 U,W	3.0 U,J,W
Barium	42.0 U	42.0 U	56.70 B	59.10 B	23.0 U	42.0 U
Beryllium	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U
Cadmium	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Calcium	59000	223000	305000	294000	280000	138000
Chromium	30.2 U,J,*	21.10 U,J,*	12.80 U,J,*	15.10 U,J,*	9.0 U	20.70 U,J,*
Cobalt	14.0 U	14.0 U	14.0 U	14.0 U	9.0 U	14.0 U
Copper	10.0 U	10.0	10.0 U	10.0 U	11.0 U	10.0 U
Iron	87.9 B,J	39.0 U	39.3 B,J	77.9 B,J	29.0 U	47.8 B,J
Lead	2.0	2.0	2.0	2.0	2.0 U	2.0
Magnesium	20300	38600	170000	164000	529000	35600
Manganese	65.1	811	509	503	110.0	497
Mercury	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Nickel	11.0 U	11.0 U	11.0 U	11.0 U	20.3 B	11.0 U
Potassium	905 B,J	11500	1130 B,J	1120 B,J	962.0 U	1980 B,J
Selenium	1.0 U,J,W	1.0 U,J,W	1.0 U,J,W	1.0 U,J,W	1.0 U	1.0 U,J,W
Silver	9.0 U	9.0 U	9.0 U	9.0 U	8.0 U	9.0 U
Sodium	3450 B,J	579000	97600	107000	81400	29400
Thallium	4.0 U	4.0 U,J,W	4.0 U,J,W	4.0 U,J,W	4.0 U,W	4.0 U,J,W
Vanadium	8.0 U	8.0 U	8.0 U	8.0 U	8.0 U	8.0 U
Zinc	6.0 U	6.0 U	6.0 U	6.0 U	5.0 U	6.0 U
Cyanide	10.0 U	37.0	10.0 U	10.0 U	10.0 U	10.0 U

B - Component was detected in method blank

J - Analyte was positively identified.

U - Analyte is not present above associated value.

W - Post-digestion spike is out of control limits.

* - Duplicate analysis not within control limits.

TABLE 4F: SUMMARY OF SOIL SAMPLES ABOVE BACKGROUND CRITERIA (MEAN +2S),
HI-MILL MANUFACTURING, HIGHLAND, MICHIGAN.

SAMPLE ID	DEPTH (feet)	ALUMNIUM	CHROMIUM	COPPER	NICKEL	SILVER	ZINC
A1-0	0-0.5		12.40		8.60		33.70
A1-1	3.92	8730.00	14.90	10.30	10.40		33.10
A2-0	0-0.5	12300.00	19.40	9.60	13.90		37.70
A2-1	6.5	8600.00	13.70	14.00	17.60		39.00
A3-0	0-0.5						33.60
A3-1	3.0	19500.00	32.40	24.10	28.70		52.30
A4-0	0-0.5	8620.00			8.70		36.50
B1-0	0-0.5	10200.00	18.60	112.00	15.50		259.00
B1-0-D	0-0.5	11900.00	27.10	212.00	18.60	3.70	834.00
B1-1	3.33						
B2-0	0-0.5	13800.00	21.30	11.70	12.70		41.10
B2-1	3.67	14500.00	21.30	21.70	23.80		48.00
B3-0	0-0.5	8200.00	13.50	13.80	8.20		38.60
B3-1	4.17	24300.00	32.00	24.00	32.10		60.80
B4-0	0-0.5	7620.00			8.20		31.20
B5-0	0-0.5	7400.00					38.10
B5-0-D	0-0.5						35.70
C1-0	0-0.5	18100.00	25.40	24.40	31.70		53.40
C1-1	1.5	16900.00	25.30	16.20	26.60		49.10
C2-0	0-0.5	16000.00	21.90	16.60	18.40		42.10
C2-1	2.5-3.0	20400.00	27.40	16.30	26.20		48.10
C3-0	0-0.5	14100.00	19.20	10.30	14.70		47.40
C3-0-D	0-0.5	14600.00	23.70		22.50		44.20
C3-1	3.0-3.5	19500.00	26.70	18.20	28.70		50.50
C4-0	0-0.5	8960.00	14.30	11.20	8.50		44.60
C5-0	0-0.5				8.20		30.70
D2-0	0-0.5	12200.00	23.10	289.00	17.30		332.00
D2-1	3.25-3.75	21100.00	29.90	19.10	26.90		41.90
D3-0	0-0.5						
D3-1	2.25-2.75	12200.00	18.60		19.40		40.60
D4-0	0-0.5	9720.00	53.40	14.40	14.00		44.00
D5-0	0-0.5						31.20
D6-0	0-0.5						
E2-0	0-0.5	10300.00	161.00	987.00	24.00		350.00
E2-1	2.5-3.0	13300.00	70.10	630.00	23.20		244.00
E3-0	0-0.5	10500.00	13.10	25.30	10.40		59.40
E3-1	2.5-3.0	18500.00	23.70	23.00	21.60		56.60
E4-0	0-0.5	8480.00		9.50	11.50		43.70
E5-0	0-0.5	11600.00	16.50	10.80	13.80		42.80
E6-0	0-0.5						32.10
E7-0	0-0.5	10400.00	18.70		16.40		38.70
F3-0	0-0.5	20800.00	68.90	1570.00	33.30		185.00
F3-0-D	0-0.5	14100.00	44.70	1150.00	26.90		163.00
F3-1	3.0-3.5	22500.00	41.10	121.00	33.70		74.90

TABLE 4F: SUMMARY OF SOIL SAMPLES ABOVE BACKGROUND CRITERIA (MEAN +2S),
HI-MILL MANUFACTURING, HIGHLAND, MICHIGAN.

SAMPLE ID	DEPTH (feet)	ALUMNIUM	CHROMIUM	COPPER	NICKEL	SILVER	ZINC
F4-0	0-0.5		14.20	524.00	10.70		103.00
F4-1	3.5-4.0	18900.00	31.30		27.70		56.20
F5-0	0-0.5	17500.00	26.30		19.90		55.80
F6-0	0-0.5						41.10
F7-0	0-0.5	8510.00			9.40		37.10
F7-0-D	0-0.5	7340.00			9.40		35.80
F8-0	0-0.5	12300.00	15.50	7.80	19.20		44.80
G3-0	0-0.5			18.10			33.20
G3-1	5.0-5.5	20300.00	30.10	11.40	22.20		42.10
G3/H4-0	0-0.5			10.80			
G3/H4-1	2.5-3.0		13.40	28.10	11.70		33.20
G3/H4-2	11.0-11.5		118.00	222.00	12.90		73.10
G3/H4-3	14.0-14.5	17100.00	28.20	22.40	27.60		59.10
G4-0	0-0.5						
G4-1	2.5-3.0				10.10		34.40
G4-2	11.33-11.92			12.70			
G4-2-D	11.33-11.92				9.00		
G4-3	15.0-15.5	11100.00	22.00		22.80		46.30
G5-0	0-0.5		14.60	25.10	14.70		40.50
G5-2	2.5-3.0	22200.00	34.30	25.20	33.00		62.30
G6-0	0-0.5				12.10		42.30
G6-1	2.5-3.0	19500.00	36.60	37.00	34.60		61.20
G6-2	3.0-3.5	15800.00	20.00		25.90		48.60
G6-3	5.5-6.0	17500.00	26.80	20.10	28.00		53.50
G7-0	0-0.5	12100.00	139.00	1480.00	27.50	22.50	664.00
G8-0	0-0.5	18100.00	20.50	14.50	18.00		49.60
H3-0	0-0.5		17.90	54.50			34.70
H3-0-D	0-0.5						
H3-1	NA						
H3/I3-0	0-0.5		50.00	201.00	9.00		34.20
H3/I3-1	NA	9170.00	248.00	1850.00	21.50		89.40
H3/I4-1	6.0-6.5						
H3/I4-2	11.83-12.33	10800.00	89.50	615.00	15.20		84.50
H3/I4-3	13.0-13.5	13700.00	21.60		26.50		56.70
H4-0	0-0.5						32.60
H4-1	NA		48.00	68.20	16.00		53.80
H4-1-D-HO	2.5-3.0						
H4/I5-0	0-0.5		15.60	19.40	9.40		47.40
H4/I5-1	2.5-3.0		13.40	29.60	8.60		87.00
H4/I5-2	5.33-5.83						
H4/I5-3	9.0-9.5	9940.00	17.80	10.10	22.50		46.50
H5-0	0-0.5	9810.00	108.00	373.00	15.20		81.70
H5-1	2.5-3.0	14300.00	24.10		19.80		33.30

TABLE 4F: SUMMARY OF SOIL SAMPLES ABOVE BACKGROUND CRITERIA (MEAN +2S),
HI-MILL MANUFACTURING, HIGHLAND, MICHIGAN.

SAMPLE ID	DEPTH (feet)	ALUMNIUM	CHROMIUM	COPPER	NICKEL	SILVER	ZINC
H6-0	0-0.5	8920.00	32.10	57.60	15.70		44.60
H6-0-D	0-0.5	8950.00	63.70	105.00	18.50		43.00
H6-1	2.5-3.0	18300.00	97.00	309.00	30.20		60.70
H6-2	4.17-4.67	13200.00	24.30		19.60		39.40
H6-3	7.0-7.5	11300.00	13.30		25.10		40.00
H7-0	0-0.5	18200.00	196.00	813.00	30.70		107.00
H7-1	2.5-3.0	27100.00	615.00	2500.00	27.90		89.70
H7-2	5.5-5.92	15900.00	23.10	23.90	25.90		81.20
H7-3	8.5-9.0	19000.00	22.50		34.00		62.70
H8-0	0-0.5	21500.00	36.80	770.00	22.20		90.90
I3-1	7.0-7.5		17.40	32.90	9.00		47.20
I3-2	12.67-13.17	9330.00	16.70	11.90	12.50		41.60
I3-3	16.0-16.5	10900.00	18.60		21.30		48.20
I4-1	5.0-5.5						
I4-2	9.17-9.67	11700.00	30.70	196.00	22.00		59.90
I4-3	13.0-13.5	10300.00	18.30		20.30		45.70
I4-3-D	13.0-13.5	10000.00	18.70		24.70		48.40
I5-0	0-0.5		15.90	37.10	8.50		40.50
I5-1	2.5-3.0	14100.00	302.00	1820.00	30.40	4.60	75.40
I5-2	5.5-6.0	17500.00	1620.00	4440.00	25.10	12.50	101.00
I5-3	8.5-9.0		18.60	42.40	10.80		
I6-0	0-0.5	14500.00	208.00	829.00	29.30		184.00
I6-0-D	0-0.5	18400.00	127.00	483.00	30.00		186.00
I6-1	2.5-3.0	12400.00	22.60	29.40	18.70		37.50
I6-2	5.5-6.0	7660.00			17.10		
I6-3	8.5-9.0	14900.00	21.00		26.60		55.90
I7-0	0-0.5	23700.00	294.00	4630.00	23.20		113.00
I7-1	2.5-3.0		23.50	125.00			
I8-0	0-0.5	24300.00	40.40	82.20	26.20		81.10
J5-0	0-0.5	18200.00	163.00	735.00	20.00		573.00
J5-1	2.5-3.0				9.30		
J5-2	3.5-4.0				9.20		
J5-3	6.5-7.0	17300.00	28.40		31.20		58.90
J6-0	0-0.5	26900.00	109.00	968.00	17.90		628.00
J6-1	2.5-3.0	14000.00	24.20	26.60	19.70		55.10
J6-1-D	2.5-3.0						
J7-0	0-0.5	27100.00	67.30	336.00	26.90		119.00
K3-0	0-0.5						
K3-1	2.5-3.0	21200.00	43.40	120.00	41.50		66.90
K4-0	0-0.5		16.40	340.00	11.20		298.00
K4-0-D	0-0.5		16.40	55.70	12.30		204.00
K4-1	3.0-3.5	13400.00	20.40		26.10		38.70
K5-0	0-0.5	17600.00	23.60	43.00		3.80	83.60

TABLE 4F: SUMMARY OF SOIL SAMPLES ABOVE BACKGROUND CRITERIA (MEAN +2S),
HI-MILL MANUFACTURING, HIGHLAND, MICHIGAN.

SAMPLE ID	DEPTH (feet)	ALUMNIUM	CHROMIUM	COPPER	NICKEL	SILVER	ZINC
K6-0	0-0.5	24800.00	56.40	68.00	24.60	3.80	844.00
L3-0	0-0.5	12200.00	42.40	913.00	19.90		86.60
L3-1	2.5-3.0	17500.00	165.00	981.00	30.20		58.20
L3-1-D	2.5-3.0	15400.00	917.00	2110.00	18.10		52.40
L4-0	0-0.5	25200.00	49.00	182.00	29.70		81.10
L5-0	0-0.5	25900.00	36.10	34.10	17.70		70.70
M3-0	0-0.5	18200.00	4420.00	3950.00	15.10		79.20
M4-0	0-0.5	21900.00	105.00	5010.00	17.40		81.00
OG1-0	0-0.5	11100.00	18.80		14.90		34.90
OG2-0	0-0.5	9370.00	16.70	10.90	11.40		41.30
OG3-0	0-0.5			8.00	11.00		33.30
OG4-0	0-0.5	9770.00	18.00	13.70	12.50		55.50
RS01-0	0.25-0.75	9730.00	16.30	12.10	9.80		57.50
RS01-2	1.25-1.75	9830.00	27.00	10.50	8.40		73.60
RS01-3	4.0-4.67	12200.00	19.10	11.80	18.30		42.00
RS12-0	0.5-1.0	13300.00	18.10	15.50	24.30		55.80
RS12-3	4.0-4.5	11300.00	22.70		21.40		46.40
RS23-0	0.25-0.75	9890.00	18.00		13.20		45.20
RS23-1	2.5-3.0	10900.00	21.30		18.90		38.40
RS23-3	5.6-6.0	13800.00	24.30		24.40		52.20
RS23-3-D	5.6-6.0	11900.00	19.40		24.40		48.20
RS34-0	0.5-1.0	14500.00	23.70		20.70		58.10
RS34-2	2.5-3.0	15000.00	23.70		27.70		56.20
RS34-3	5.5-6.0	11300.00	19.80		20.30		47.70
ST01-0	0.5-1.0	13900.00	27.10	13.50	10.80		65.90
ST01-3	3.5-4.0	12900.00	16.70	14.80	20.40		40.30
ST12-0	0.5-1.0	11400.00	62.40	15.90	15.70		77.70
ST12-3	4.0-4.5	12400.00	17.80	15.30	19.60		39.80
ST23-0	0.5-1.0	8820.00	14.70	13.50	17.70		58.10
ST23-0-D	0.5-1.0						
ST23-2	2.67-3.5	9930.00	14.50	15.90	20.90		38.50
ST23-3	6.0-6.5	13600.00	17.30	17.70	22.70		45.50
ST34-0	0.5-1.0	9970.00	16.10	51.80	15.50		100.00
ST34-2	1.75-2.25	17300.00	21.80	42.70	30.70		61.70
ST34-3	4.67-5.33	10500.00	17.90	12.70	17.90		39.10
WV01-0	0.5-1.0		74.50	285.00	9.60		45.10
WV01-1	2.0-2.5				8.90		28.70
WV01-2	5.67-6.17	9410.00	16.90	12.80	15.20		28.90
WV01-3	8.67-9.17	13800.00	24.40	9.00	30.00		55.80
WV01-3-D	8.67-9.17						
XW01-0	0.33-0.83		12.50	43.70	11.90		77.10
XW01-1	2.0-2.5		17.60	35.30	11.30		47.40
XW01-2	6.5-7.0		12.30		14.20		
XW01-3	9.5-10.0	13900.00	24.50		29.90		60.70

**TABLE 4F: SUMMARY OF SOIL SAMPLES ABOVE BACKGROUND CRITERIA (MEAN +2S),
HI-MILL MANUFACTURING, HIGHLAND, MICHIGAN.**

SAMPLE ID	DEPTH (feet)	ALUMNIUM	CHROMIUM	COPPER	NICKEL	SILVER	ZINC
XW12-1	2.0-2.5	15500.00	39.70	119.00	18.70		63.50
XW12-2	6.0-6.5	7760.00	42.00	130.00	12.40		38.30
XW12-3	9.0-10.5	14500.00	24.60	13.90	28.20		53.10
XW12-3-D	9.0-10.5						
YX01-0	0.33-0.83			54.20	10.20		78.70
YX01-1	2.0-2.5			8.40	8.70		40.00
YX01-2	5.33-5.0				13.60		
YX01-3	8.17-8.67	14500.00	21.00	17.70	29.60		49.70
YX12-0	0-0.5						
YX12-1	2.0-2.5						
YX12-2	6.5-7.5	18300.00	38.90	135.00	23.60		46.90
YX12-3	9.5-10.0						
YX12-3-D	9.5-10.0	12000.00	21.70	10.60	28.70		54.90
ZY01-0	0.33-0.83			12.70	9.80		31.00
ZY01-1	2.0-2.5			10.90	11.30		40.30
ZY01-2	6.0-6.5		12.90	17.90	12.30		
ZY01-3	9.0-9.5	13600.00	19.20	20.20	29.00		51.00
ZY01-3-D	9.0-9.5						
ZY12-0	NA			9.10			37.00
ZY12-1	NA				9.60		38.30
ZY12-2	NA	9210.00	19.60	162.00	19.90		39.20
ZY12-3	NA	14500.00	25.50		30.60		55.60

PART 2: ANALYTICAL LABORATORY DATA VALIDATION

**FINAL TECHNICAL MEMORANDUM
HI-MILL MANUFACTURING
HIGHLAND, MICHIGAN**

June 1991

Prepared for:

**Hi-Mill Manufacturing Company
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Highland, MI 48031**

Prepared by:

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PART 2: ANALYTICAL LABORATORY DATA VALIDATION REPORT

FINAL TECHNICAL MEMORANDUM HI-MILL MANUFACTURING COMPANY

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PART 2: ANALYTICAL LABORATORY DATA VALIDATION

QUALITY ASSURANCE SUMMARY

This report presents the review and validation of sample data for the Hi-Mill facility in Highland, Michigan. This review was undertaken to determine the usability of existing data from the Draft Remedial Investigation/Feasibility Study (RI/FS) report submitted to USEPA by Techna in the summer of 1990. The RI/FS sampling plan involved the examination of soil, ground water, surface water, and sediments from areas near this facility. Analytical tests included volatile organics, semi-volatile organics, metals, cyanide, nitrogen species, and hexavalent chromium. Data were evaluated according to the data quality objectives set forth in the Quality Assurance Project Plan (QAPP); Functional Guidelines for Evaluating Inorganics Analyses (USEPA 1988); and Functional Guidelines for Evaluating Organics Analyses (USEPA 1988). The data evaluation was performed at a near-Contract Laboratory Program (CLP) level. Due to the amount of information available for review and the short timetable to process this information, raw data were not reviewed unless it was necessary to resolve a significant problem.

Data were reviewed and a proper decision made as to usability with the quality assurance information that was immediately available. Items that were present for thorough review were:

Holding Times
Gas Chromatography/Mass Spectroscopy Tune Criteria
Calibrations
Blanks
Surrogate Recoveries
Matrix/Matrix Spike Duplicates
Field Duplicates
Internal Standards Performance
ICP Interference Check Samples
Laboratory Control Samples
ICP Serial Dilution

The data validation and review process follows the scheme set down in the above-mentioned EPA guidelines. Each of the heading items has certain specific criteria against which the data package is evaluated. Each of these criteria must also be judged by experience of the validator as to whether the effect, positive or negative, influences the usability of the data. The goal of this data validation process is to ensure the integrity of data that will be usable not to arbitrarily disqualify data. Data is usually classified at one of three levels of data usability.

Qualitative (Level A) data has usually failed some quality assurance function and has been given and estimated ("J") code. Data is somewhat suspect but may be used in the decision making process. Qualitative data should not be used for remediation activities.

Quantitative (Level B) data must meet all specified quality assurance functions. This data has no qualifications and may be used for any purpose.

Unusable data has failed the requirements within the quality assurance framework at significant levels. This data must not be used for any purpose. This data should be coded as "R" on reports. This is the designation as unusable.

Analytical data were judged against the above list and also against the type of matrix and location of samples in order to ascertain usability. Sample data were reviewed according to matrix type (i.e. soil/water), category (i.e. organic/inorganic), and analytical procedure group (i.e. metals/volatiles/semi-volatiles, etc.).

ORGANICS

Volatile Organics Analysis (VOA)

The proper amount of quality assurance activity was present for the VOA. Almost every sample had some volatile compounds present at low levels. Upon examination of the quality assurance information, the majority of these positive hits were deemed to be contaminants from the testing process. Application of the 10X rule involving contamination of blanks by the common lab contaminants: acetone, methylene chloride, toluene, 2-butanone, and phthalates, resulted in the great majority of positive hits being eliminated from consideration as pollutants at this location. The overall quality of the analyses was good. Most data are judged to be quantitative, and some to be qualitative but usable. In general, the water samples met more quality assurance requirements than the soil/sediment samples. This is a function of the ease of the matrix to analyze and handle. More details of the VOA validation are present in later sections of this report.

Semi-Volatile Organics Analysis

The proper amount of quality assurance activity was present for the semi-volatile organics. There were relatively few compounds detected in this analysis. The quality of the analysis was good, although there were many failures of some compounds in the initial and continuing calibration verification samples. These were deemed to have a minimal effect on the quality of the analysis since the associated compounds were not detected. However, the laboratory should have made a better effort at meeting requirements. Most of the data are judged to be quantitative and usable.

Pesticides/PCB Analysis

The full package of information was not available for review. Based on the available data, the correct amount of quality assurance activities were run. The overall data quality was good. Data are judged quantitative and usable.

INORGANICS

Metals/Cyanide Analysis

This was the largest group of analyses. The required amount of quality assurance was present for this group of analytes. The overall quality of the data is good. The laboratory data package was complete for data review. There are some analytes that were found to be out of compliance with the specified limits. These were, for the most part, correctly marked on the laboratory reports. There were a few quality assurance items that the laboratory overlooked such as the QAPP limits for holding time on cyanide, and the application of the blank contaminant rule, but these did not generally affect data quality on this set of analyses. Most data are judged quantitative, and some are qualitative but usable. More details are included later in this report.

INORGANICS (Cont'd)

Miscellaneous Parameters - Hexavalent Chromium/Nitrogen Compounds

A complete data package was not available for review. The information available shows that an acceptable amount of quality assurance was performed. The data are judged quantitative and usable.

CONCLUSION

Data Usability

Based on the information available for review, the majority of the analytical data for this project are usable either as quantitative or qualitative for the purposes of establishing facts for the RI. The estimates made as to qualitative versus quantitative, or usable versus unusable, are made with absence of complete data packages due to the short time limit for evaluating this information. The following table gives approximate percentages of each data quality.

DATA USABILITY
(BASED ON DATA VALIDATION WITHOUT RAW DATA)

Groundwater/Surface Water			Soil/Sediment			
	% Qualitative	% Quantitative	% Unusable	% Qualitative	% Quantitative	% Unusable
Organics:						
Volatile	10	90	<1	25	75	<1
Semi-Volatile	<5	95	0	<5	95	0
Pesticides	0	100	0	0	100	0
Inorganics:						
Metals/Cyanide	10	90	0	30	70	0
Nitrogen	0	100	0	-	-	-
Hexchromium	0	100	0	0	100	0

ORGANICS, VOLATILE

Soil/Sediment Matrix

Holding Times

Nearly all holding times were equivalent or less than the regulatory limits for water samples. There was SDG HMS-RS01-0 that had samples requiring rechecks. The rechecks were run well past conventional hold times and data associated with these samples should be qualified as estimated. The reason for the recheck was the failure of quality assurance. The sample QC should have been reviewed more rapidly to allow for recheck within an acceptable time period. The samples in question are:

<u>Sample ID</u>	<u>Sample Collection Date</u>	<u>Sample Analysis Date</u>	<u>Recheck Date</u>
HMS-I4-2	2-6-90	2-7-90	N/A
HMS-I4-2 RE	2-6-90	2-7-90	2-24-90
G4-2	2-6-90	2-7-90	N/A
G4-2 RE	2-6-90	2-7-90	2-24-90
RS23-3	1-29-90	2-5-90	N/A
RS23-3 RE	1-29-90	2-5-90	2-26-90
STOI-3	1-30-90	2-5-90	N/A
STOI-3 DL*	1-30-90	2-5-90	2-24-90
ST34-0	1-30-90	2-5-90	N/A
ST34-0 RE	1-30-90	2-5-90	2-24-90
ST34-2	1-30-90	2-5-90	N/A
ST34-2RE	1-30-90	2-5-90	2-26-90
WVO1-2	1-31-90	2-6-90	N/A
WVO1-2 DL	1-31-90	2-6-90	N/A
YX12-3	1-31-90	2-6-90	N/A
YX12-3 RE	1-31-90	2-6-90	2-24-90
ZY12-1D	1-31-90	2-6-90	N/A
ZY12-1D RE	1-31-90	2-6-90	2-27-90
BG2-0	2-8-90	2-17-90	N/A
BG2-0 RE	2-8-90	2-17-90	2-28-90

* Samples requiring dilution.

These samples were the exceptions to the rule. Holding times were observed well throughout the project. The above samples data can be used qualitatively.

GC/MS Tune

GC/MS tuning with BFB were within specified limits.

Calibration

Most calibrations were within acceptable regulatory limits. The following are SDG analytes that exceeded limits. Corresponding group data for each analyte is qualified as estimated. The calibration review includes both Initial Calibration Verification (ICV) and Continuing Calibration Verification (CCV).

QA FAILURE

<u>SDG</u>	<u>ANALYTE</u>	<u>ICV</u>	<u>DATE</u>	<u>CCV</u>	<u>DATE</u>
HMS-BG4-0	2-Butanone	RRF,%RSD	2-15-90	RRF,%D	2-16-90
HMS-BG4-0	Acetone	%RSD	2-15-90	%D	2-16-90
HMS-BG4-0	Methylene Chloride	%RSD	2-15-90		
HMS-BG1-0*	Acetone	%RSD	2-17-90	%D	2-17-90
HMS-BG1-0	2-Butanone	%RSD	2-17-90	RRF,%D	2-17-90
HMS-BG1-0	Acetone	%RSD	2-23-90	%D	2-24-90
HMS-BG1-0	Bromomethane	%RSD	2-23-90		
HMS-BG1-0	2-Butanone	%RSD	2-23-90	%D	2-24-90
HMS-BG1-0	Vinyl Acetate	%RSD	2-23-90		
HMS-BG1-0	2-Hexanone	%RSD	2-23-90	%D	2-24-90
HMS-XW01-0	2-Butanone	RRF	2-4-90	RRF,%D	2-4-90
HMS-XW01-0	Acetone	%RSD	2-4-90	RRF,%D	2-4-90
HMS-XW01-0	Vinyl Acetate	%RSD	2-4-90	%D	2-4-90
HMS-XW01-0	T-1,3-Dichloropropane			%D	2-4-90
HMS-XW01-0	4-Methyl-2-Pentanone			%D	2-4-90
HMS-XW01-0	2-Hexanone			%D	2-4-90
HMS-BG6-1	Acetone	%RSD	3-8-90	%D	3-8-90
			3-12-90		
HMS-BG6-1	2-Butanone	%RSD	3-8-90	%D	3-8-90
			3-12-90		
HMS-BG6-1	2-Hexanone	%RSD	3-8-90	%D	3-8-90
			3-12-90		
HMS-BG6-1	4-Methyl-2-Pentanone	%RSD	3-8-90	%D	3-8-90
			3-12-90		
HMS-RS01-0	2-Butanone	RRF,%RSD	2-5-90	RRF	2-8-90
HMS-RS01-0	Methylene Chloride	%RSD	2-5-90		
HMS-RS01-0	Acetone	%RSD	2-5-90	%D	2-8-90
HMS-RS01-0	Chloromethane			%D	2-8-90
HMS-RS01-0	Bromomethane	%RSD	2-23-90	%D	2-26-90
HMS-RS01-0	Acetone	%RSD	2-23-90	%D	2-24-90
HMS-RS01-0	2-Butanone	%RSD	2-23-90	%D	2-26-90
HMS-RS01-0	Vinyl Acetate	%RSD	2-23-90		
HMS-RS01-0	2-Hexanone			%D	2-24-90
					2-26-90
HMS-RS01-0	Chloroethane			%D	2-26-90
HMS-RS01-0	1,2-Dichloroethane			%D	2-26-90
HMS-RS01-0	1,1,1-Trichloroethane			%D	2-26-90
HMS-RS01-0	Carbon Tetrochloride			%D	2-26-90
HMS-RS01-0	Bromodichloromethane			%D	2-26-90

* Continuing Calibration Verification for HMS-BG2-0D on 2-23-90 had 14 compounds outside QC limits. The sample(s) analyzed on this date are qualified as unusable (R).

The above SDG analytes should be qualified as estimated values due to the QC failures. The analytes that consistently appear on this list are common laboratory contaminants. It is a consideration that laboratory contamination is resulting in poor calibration checks.

Blanks

There are many blanks that have varying levels of analytes present. Although the laboratory qualified samples with analytes in the blanks, they did not correctly apply the validation guidelines as stated in Functional Guidelines for Evaluating Organics Analyses, (USEPA, 1988, page 12, IV). Blanks, paragraph D, states that no positive results should be reported unless the concentration in the sample exceeds 10 times the blank amount for the common lab contaminants, or 5 times the amount of any other compound. Qualification should be based on the associated blank having the highest concentration of a contaminant. Correct application of this rule raises the analyte detection limit, resulting in many compounds being reported as not detected. This results in a significant decrease in the detected volatile compounds data in the Technical Memorandum. The majority of samples with these analytes will be flagged as "U", undetected. As stated previously, there seems to be indications of significant laboratory contaminants in the volatile organics analysis as indicated by these contaminants in the blanks.

METHOD BLANK CONTAMINATION

<u>SDG</u>	<u>Analyte</u>	<u>Blank</u>	<u>Date</u>	<u>Level</u>
HMS-BG4-0	Methylene Chloride	VBK1	2-16-90	0.001
HMS-BG1-0	Methylene Chloride	VBK1	2-17-90	0.002
HMS-BG1-0	2-Butanone	VBK3	2-24-90	0.004
HMS-BG1-0	Methylene Chloride	VBK4	2-28-90	0.002
HMS-BG1-0	Acetone	VBK4	2-28-90	0.020
HMS-BG1-0	2-Butanone	VBK4	2-28-90	0.004
HMS-XW01-0	Methylene Chloride	VBK1	2-6-90	0.003
HMS-XW01-0	Toluene	VBK1	2-6-90	0.002
HMS-BG6-1	Methylene Chloride	VBK1	3-9-90	0.006
HMS-BG6-1	Methylene Chloride	VBK2	3-12-90	0.007
HMS-RS01-0	Acetone	VBK1	2-7-90	0.010
HMS-RS01-0	Methylene Chloride	VBK1	2-7-90	0.002
HMS-RS01-0	Methylene Chloride	VBK2	2-8-90	0.003
HMS-RS01-0	Toluene	VBK2	2-8-90	0.001
HMS-RS01-0	2-Butanone	VBK4	2-24-90	0.004
HMS-RS01-0	Acetone	VBK5	2-26-90	0.021
HMS-RS01-0	2-Butanone	VBK5	2-26-90	0.013
HMS-RS01-0	Methylene Chloride	VBK6	2-27-90	0.001
HMS-RS01-0	2-Butanone	VBK6	2-27-90	0.003
HMS-RS01-0	Acetone	VBK7	2-4-90	0.020
HMS-RS01-0	Methylene Chloride	VBK7	2-4-90	0.002
HMS-RS01-0	Toluene	VBK7	2-4-90	0.002
HMS-RS01-0	2-Hexanone	VBK7	2-4-90	0.003
HMS-RS01-0	Methylene Chloride	VBK8	2-5-90	0.003
HMS-RS01-0	Methylene Chloride	VBK9	2-5-90	0.011
HMS-RS01-0	Methylene Chloride	VBK10	2-6-90	0.003
HMS-RS01-0	Toluene	VBK10	2-6-90	0.002
HMS-RS01-0	Methylene Chloride	VBK11	2-6-90	0.005
HMS-RS01-0	Toluene	VBK11	2-6-90	0.002
HMS-RS01-0	Methylene Chloride	VBK12	2-7-90	0.001
HMS-RS01-0	Methylene Chloride	VBK12	2-13-90	0.002

Surrogate Recovery

The surrogate recoveries were within control limits except on some samples from SDG HMS-RS01-0. These samples were reanalyzed and surrogates fell within acceptable ranges. Reanalysis did, however, push several samples past holding times. Data from these samples will be labeled as estimated according to holding time exceedance.

Matrix Spike/Matrix Spike Duplicate

Data on MS/MSD was within QC limits except for toluene on SDG HMS-BG1-0. The sample exceeded percent recovery but had a very low relative percent difference. It is not thought to be of significant impact on data quality.

Field Duplicates

The field duplicates had acceptable agreement among themselves.

Internal Standards Performance

Internal standards (IS) final results were within QC limits. SDG HMS-BG1-0 and HMS-RS01-0 had initial IS out of compliance. Subsequent reanalysis brought results in control but did result in holding time exceedance.

TCL Compound Identification

Raw data were not available for a proper review.

Compound Quantitation and Reported Detection Limits

Raw data were not available for review of quantitation.

Tentatively Identified Compounds

A few samples and blanks indicated TICs. Raw data were not available for review. Levels and numbers of TICs were not considered significant.

VOLATILE ORGANICS

Organics- Ground Water, Surface Water

Holding Times

All sample holding times were within QAPP specified limits.

GC/MS Tune

All GC/MS tunes for associated samples were within specified limits.

Calibration

Most calibrations were within specified limits. The following table contains SDGs, analytes, and QC failures. Results associated with the analytes in these SDGs will be qualified as estimated.

QC FAILURES					
<u>SDG</u>	<u>ANALYTE</u>	<u>ICV</u>	<u>DATE</u>	<u>CCV</u>	<u>DATE</u>
HMW-SW-1	Methylene Chloride	%RSD	3-23-90		
HMW-SW-1	Bromomethane	%RSD	3-23-90		
HMW-SW-1	2-Butanone	%RSD	3-23-90		
HMW-IW-1	Acetone	%RSD	3-23-90	%D	3-28-90
			3-26-90		
HMW-IW-1	2-Butanone	%RSD	3-23-90	%D	3-28-90
HMW-IW-1	Vinyl Acetate	%RSD	3-26-90	%D	3-23-90
HMW-IW-1	Methylene Chloride	%RSD	-	%D	3-29-90
HMW-DW-2	Acetone	%RSD	3-26-90	%D	3-28-90
HMW-DW-2	Vinyl Acetate	%RSD	3-26-90	%D	3-28-90
HMW-DW-2	2-Butanone			%D	3-29-90
HMW-DW-2	Methylene Chloride			%D	3-29-90
HMW-SW-11	Bromomethane	%RSD	3-23-90		
HMW-SW-11	Acetone	%RSD	3-23-90		
HMW-SW-11	2-Butanone	%RSD	3-23-90		
HMW-DW-3	Acetone	%RSD	3-26-90	%D	3-28-90
HMW-DW-3	Vinyl Acetate	%RSD			
HMW-DW-3	2-Butanone			%D	3-28-90
HMW-DW-3	Methylene Chloride			%D	3-29-90
HMW-DW-1	Acetone	%RSD	3-26-90	%D	3-26-90
HMW-DW-1	Vinyl Acetate	%RSD	3-26-90		
HMW-DW-1	2-Butanone			%D	3-26-90
HMW-SW-4	2-Butanone	%RSD	3-22-90		
			3-23-90		
HMW-SW-4	Bromomethane	%RSD	3-23-90		
HMW-SW-4	Acetone	%RSD	3-23-90		
HMW-SW-4	Vinyl Acetate			%D	3-23-90

Blanks

There is contamination in nearly all of the associated method, trip, and field blanks. Common lab contaminants are present at significant levels as indicated by the following table.

TRIP AND METHOD BLANK CONTAMINATION
AND ASSOCIATED SAMPLE GROUPS

<u>SDG</u>	<u>ANALYTE</u>	<u>BLANK</u>	<u>DATE</u>	<u>LEVEL</u>
HMW-SW-1	Acetone	VBLK 1	3-24-90	0.015
HMW-SW-1	2-Butanone	VBLK 1	3-24-90	0.011
HMW-SW-1	Methylene Chloride	VBLK 1	3-24-90	0.008
HMW-SW-1	Toluene	Trip	3-19-90	0.001
HMW-IW-1	Acetone	VBLK 1	3-24-90	0.015
HMW-IW-1	2-Butanone	VBLK 1	3-24-90	0.011
HMW-IW-1	Methylene Chloride	VBLK 1	3-24-90	0.008
HMW-IW-1	Toluene	VBLK 2	3-26-90	0.003
HMW-IW-1	Acetone	VBLK 2	3-26-90	0.014
HMW-IW-1	2-Butanone	VBLK 2	3-26-90	0.006
HMW-IW-1	Methylene Chloride	VBLK 2	3-26-90	0.004
HMW-IW-1	Acetone	VBLK 3	3-28-90	0.004
HMW-IW-1	Methylene Chloride	VBLK 3	3-28-90	0.006
HMW-IW-1	Acetone	VBLK 4	3-29-90	0.011
HMW-IW-1	Methylene Chloride	VBLK 4	3-29-90	0.003
HMW-IW-1	Acetone	Trip	3-20-90	0.008
HMW-IW-1	2-Butanone	Trip	3-20-90	0.004
HMW-IW-1	Methylene Chloride	Trip	3-20-90	0.003
HMW-IW-1	Toluene	Trip	3-20-90	0.002
HMW-DW-2	Acetone	VBLK 1	3-26-90	0.014
HMW-DW-2	2-Butanone	VBLK 1	3-26-90	0.006
HMW-DW-2	Methylene Chloride	VBLK 1	3-26-90	0.004
HMW-DW-2	Toluene	VBLK 1	3-26-90	0.003
HMW-DW-2	Acetone	VBLK 2	3-28-90	0.004
HMW-DW-2	Methylene Chloride	VBLK 2	3-28-90	0.006
HMW-DW-2	Acetone	VBLK 3	3-29-90	0.011
HMW-DW-2	Methylene Chloride	VBLK 3	3-29-90	0.003
HMW-DW-2	Acetone	Field	3-21-90	0.029
HMW-DW-2	Methylene Chloride	Field	3-21-90	0.005
HMW-DW-2	Acetone	Trip	3-21-90	0.013
HMW-DW-2	Methylene Chloride	Trip	3-21-90	0.012
HMW-DW-2	Toluene	Trip	3-21-90	0.001
HMW-SW-11	Acetone	VBLK 1	3-23-90	0.011
HMW-SW-11	2-Butanone	VBLK 1	3-23-90	0.005
HMW-SW-11	2-Methyl-2-Pentanone	VBLK 1	3-23-90	0.004
HMW-SW-11	Toluene	VBLK 1	3-23-90	0.004
HMW-SW-11	Methylene Chloride	Trip	3-15-90	0.011
HMW-DW-3	Acetone	VBLK 1	3-28-90	0.004
HMW-DW-3	Methylene Chloride	VBLK 1	3-28-90	0.006
HMW-DW-3	Acetone	VBLK 2	3-29-90	0.011
HMW-DW-3	Methylene Chloride	VBLK 2	3-29-90	0.003
HMW-DW-3	Acetone	Trip	3-23-90	0.011
HMW-DW-3	Methylene Chloride	Trip	3-23-90	0.014
HMW-DW-3	Acetone	Field	3-23-90	0.009

**TRIP AND METHOD BLANK CONTAMINATION
AND ASSOCIATED SAMPLE GROUPS (Cont'd)**

<u>SDG</u>	<u>ANALYTE</u>	<u>BLANK</u>	<u>DATE</u>	<u>LEVEL</u>
HMW-DW-3	Methylene Chloride	Field	3-23-90	0.029
HMW-DW-1	Acetone	VBLK1	3-28-90	0.004
HMW-DW-1	Methylene Chloride	VBLK1	3-28-90	0.006
HMW-DW-1	Acetone	Trip	3-22-90	0.013
HMW-DW-1	Methylene Chloride	Trip	3-22-90	0.014
HMW-SW-4	Acetone	VBLK1	3-22-90	0.009
HMW-SW-4	2-Butanone	VBLK1	3-22-90	0.004
HMW-SW-4	Methylene Chloride	VBLK1	3-22-90	0.016
HMW-SW-4	Acetone	VBLK2	3-23-90	0.011
HMW-SW-4	2-Butanone	VBLK2	3-23-90	0.005
HMW-SW-4	Methylene Chloride	VBLK2	3-23-90	0.004
HMW-SW-4	Toluene	VBLK2	3-23-90	0.004
HMW-SW-4	Acetone	VBLK3	3-24-90	0.015
HMW-SW-4	2-Butanone	VBLK3	3-24-90	0.012
HMW-SW-4	Methylene Chloride	VBLK3	3-24-90	0.008
HMW-SW-4	Acetone	Trip	3-16-90	0.011
HMW-SW-4	2-Butanone	Trip	3-16-90	0.004
HMW-SW-4	Methylene Chloride	Trip	3-16-90	0.016
HMW-SW-4	Toluene	Trip	3-16-90	0.001
HMW-SW-4	Acetone	Field	3-16-90	0.017
HMW-SW-4	2-Butanone	Field	3-16-90	0.004
HMW-SW-4	Methylene Chloride	Field	3-16-90	0.009

The preceding table is comprised of compounds that are common lab contaminants. This indicates a lab problem for blanks, samples, and calibration. Analytes associated at levels less than ten (10) times the blank levels of the lab contaminants are qualified as not detected. Analytes associated with other contaminants found in the blanks at less than five (5) times the blank level are qualified as not detected. Sample HMS-SW-1 had to be diluted due to high values on some compounds. Taking into account the blank, the only detectable compounds are 1,2-dichloroethene (Total) and trichloroethene.

Surrogate Recovery

Surrogate recovery is within QAPP specified limits.

Matrix/Matrix Spike Duplicate (MS/MSD)

The laboratory was using non-QAPP QC limits for MS/MSD. The following table shows the difference in values.

<u>COMPOUND</u>	<u>LAB QC LIMITS</u>		<u>QAPP QC LIMITS</u>	
	<u>RECOVERY</u>	<u>RPD</u>	<u>RECOVERY</u>	<u>RPD</u>
Benzene	66-142	21	76-127	11
1,1-Dichloroethane	59-172	22	61-145	14
Trichloroethane	62-137	24	71-120	14
Chlorobenzene	60-130	21	75-130	13
Toluene	59-139	21	76-125	13

Laboratory validation indicates no problems, but QAPP limits put 1,1DCE out of limits on SDG HMW-IW-1 and toluene out of limits on SDG HMW-DW-2. Results of analysis cannot be judged on matrix spike data alone. Data are considered to be usable based on other QA information.

Field Duplicates

Field duplicates were within specified limits.

Internal Standards Performance

Internal standards performance was within specified limits.

TCL Compound Identification

Raw data were not available to confirm identification.

Compound Quantitation and Reported Detection Limits

Raw data were not available to review quantitation and detection limit calculation.

Tentatively Identified Compounds

No TICs were reported. Raw data were not available for review.

ORGANICS, SEMI-VOLATILE

Soil/Sediment Matrix

Holding Times

Holding time was exceeded on sample HMS-YX12-2. Data are qualified as estimated. All other samples met QAPP specified holding times.

GC/MS Tune

Specified tune criteria were met for all samples.

Calibration

The calibration QA failures are listed in the table below. There were no compounds found at levels of significance in the samples or blanks other than the detectable phthalate. It is not felt that the data are adversely effected by the calibration outside QC limits. Data associated with each calibration compound can be qualified as estimated.

**CALIBRATION TABLE
QC FAILURES**

<u>SDG</u>	<u>COMPOUND</u>	<u>ICV</u>	<u>DATE</u>	<u>CCV</u>	<u>DATE</u>
HMS-G4-2	Bis-(2-Chloroisopropyl)-Ether			%D	3-3-90 3-5-90
HMS-G4-2	2-Nitroaniline			%D	3-3-90 3-5-90
HMS-G4-2	4-Nitroaniline			%D	3-3-90
HMS-G4-2	Butylbenzylphthalate			%D	3-3-90 3-5-90
HMS-G4-2	3,3'Dichlorobenzidine			%D	3-3-90
HMS-G4-2	Bis-(2-Ethylhexyl)Phthalate			%D	3-3-90 3-5-90
HMS-G4-2	N-Nitroso-Di-N-Propylamine			%D	3-5-90
HMS-G4-2	4-Nitrophenol			%D	3-5-90
HMS-BG4-0 HMS-BG1-0	4-Chloroanilane	<u>RRF</u>	3-12-90	RRF, %D	3-13-90
HMS-BG4-0 HMS-BG1-0	Benzyl Alcohol			%RSD	3-12-90 3-15-90
HMS-BG4-0 HMS-BG1-0	4-Nitroaniline			%D	3-13-90

Blanks

Method blanks were free of contaminants.

Surrogate Recovery

The laboratory was using surrogate QC limits for data validation that did not completely agree with the QAPP. Although this was an oversight, all surrogate recoveries were within QAPP specified limits.

SURROGATE QC LIMITS

<u>COMPOUND</u>	<u>LABORATORY</u>	<u>QAPP</u>
Nitrobenzene-d5	23-120	23-120
2-Fluorobiphenyl	30-115	30-115
Terphenyl-d14	18-141	18-137
Phenol-d5	10-113	24-113
2-Fluorophenol	21-121	25-121
2,4,6-Tribromophenol	10-123	19-122

Matrix Spike/Matrix Spike Duplicate

The laboratory used many QC limits that were not in agreement with the QAPP limits. the table below compares the QC limits.

MATRIX SPIKE QC LIMITS

<u>Compound</u>	<u>Laboratory Spike QC Limits</u>	<u>Spike RPD</u>	<u>QAPP Spike QC Limits</u>	<u>Spike RPD</u>
Phenol	12-90	42	26-90	35
2-Chlorophenol	25-123	50	25-102	50
4-Chloro- 3-Methylphenol	23-103	42	26-103	33
4-Nitrophenol	10-114	50	11-114	50
Pentachlorophenol	9-109	50	17-109	47
1,4-Dichlorobenzene	28- 4	28	28-104	27
N-Nitro-di-n- Propylamine	41-126	38	41-126	38
1,2,4- Trichlorobenzene	38-107	28	38-107	23
Acenaphthene	31-137	31	31-137	19
2,4-Dinitrotoluene	24-96	47	28-89	47
Pyrene	26-142	36	35-142	36

SDG HMS-BG2-0 failed on all matrix spike relative percent difference (RPD) results and three (3) of eleven (11) were outside QC limits. No mention of reasons why were detailed in

the laboratory narrative summary. Validation by matrix spike results must have some other QC back-up in order to qualify data. Since there is no other major problem and there are essentially no significant contaminants in the samples, these data are usable.

Field Duplicates

No contaminants were reported in samples taken for field duplicates.

Internal Standards Performance

All results for internal standards are within specified limits.

TCL Compound Identification

No raw data were available for review of proper identification.

Compound Quantitation and Reported Detection Limits

No raw data were available for review of quantitation and detection limit calculations.

Tentatively Identified Compounds (TICs)

There were many TICs in the background samples. The following table lists the number of each type found in the samples. There is only an actual compound name on a few of the TICs.

BACKGROUND SAMPLE TICs

<u>SAMPLE</u>	<u>UNKNOWN</u>	<u>UNKNOWN</u> <u>ALKANE</u>	<u>UNKNOWN</u> <u>ORGANIC</u> <u>ACID</u>	<u>UNKNOWN</u> <u>PHTHALATE</u>	<u>IDENTIFIED *</u> <u>COMPOUND</u>
HMS-BG1-0	14	4	3	-	-
HMS-BG1-0D	15	2	2	1	-
HMS-BG2-0	13	5	2	-	-
HMS-BG2-1	6	-	-	1	-
HMS-BG3-0	15	3	1	-	1
HMS-BG3-1	9	3	1	1	-
METHOD BLANK	1	-	-	-	-
HMS-BG6-1		NO TICs			
HMS-BG5-1		NO TICs			
METHOD BLANK	1	-	-	-	-
HMS-YX12-2	9	1	-	1	2
METHOD BLANK	-	-	-	-	-
HMS-BG4-0	12	7	1	-	-
HMS-BG4-1	14	3	2	-	-
METHOD BLANK	1	-	-	-	-
HMS-I4-2	11	7	1	-	1
HMS-G4-2	2	-	-	-	-
METHOD BLANK	1	-	1	-	-

- * BG3-0: 5-(2-Propyl)-1,3-Benzodioxole
 YX12-2: Sulphur; Dioctyl Ester Hexanedioic Acid
 Blank: Mono(2-Ethylhexyl)Ester Hexanedioic Acid
 I4-2: Dioctyl Ester Hexanedioic Acid
 G4-2: Dioctyl Ester Hexanedioic Acid

As stated in the heading, those compounds are only tentatively identified at an estimated level.

ORGANIC - SEMI-VOLATILE

Ground Water/Surface Water

Holding Times

Hold times were within QAPP specified limits.

GC/MS/Tune

GC/MS tunes were within specified limits.

Calibration

Initial calibration verification indicates several analytes outside limits of %RSD for SDG HMW-SW-1. These exceedances were not severe enough to be of significant impact upon data quality. There were none of these compounds at detectable quantities. SDG HMW-SW-4 also had one compound outside %RSD limits. Continuing calibration data indicates one compound outside limits on SDG HMW-SW-1. None of these are of significant impact on data quality.

Blanks

No contaminants detected in blanks.

Surrogate Recovery

Surrogate recoveries were within QAPP specified limits.

Matrix Spike/Matrix Spike Duplicate

All data were within QAPP specified limits. The laboratory was using non-QAPP limits as was mentioned in the Soil/Sediment section.

Field Duplicates

Sample results were within acceptable limits.

Internal Standards Performance

Area and retention times are within specified limits.

TCL Compound Identification

Raw data were not available for review.

Compound Quantitation and Reported Detection Limits

Raw data was not available to review quantitation and detection limit calculations.

Tentatively Identified Compounds (TICs)

No raw data for reviewing TICs were available.

ORGANICS, PESTICIDES

Soil/Sediment

Holding Times

All samples were within QAPP specified holding times.

Pesticides Instrument Performance

Instrument performance meet specified criteria.

Calibration

Initial calibration meet specified limits. Continuing calibration was evaluated without reviewing raw data. Continuing calibration data meet criteria available for evaluation.

Blanks

No contaminants were present in blanks.

Surrogate Recovery

The laboratory was not using QAPP specified limits for evaluation. Only one sample YX12-2 had data outside QAPP specified surrogate limits. YX12-2 had a 20 percent recovery on Dibutylchlorendate (DBC); acceptable QAPP range is 24-154. The following table details the difference between the laboratory limits and QAPP specified limits of surrogate recovery.

<u>SURROGATE</u>	<u>LAB LIMITS</u>	<u>QAPP LIMITS</u>
Dibutylchlorendate	20-150	24-154

Matrix Spike/Matrix Spike Duplicate

All sample results were within QAPP specified limits, although the laboratory was not using QAPP limits.

SPIKE COMPOUND	LAB LIMITS		QAPP LIMITS	
	<u>% REC</u>	<u>RPD</u>	<u>% REC</u>	<u>RPD</u>
gamma-BHC(Lindane)	46-127	50	56-123	15
Heptachlor	35-130	31	40-131	20
Aldrin	31-132	43	40-120	22
Dieldrin	31-134	38	52-126	18
Endrin	42-139	45	56-121	21
4,4'-DDT	23-134	50	38-127	27

Field Duplicates

Duplicates were within acceptance limits.

Compound Identification

No raw data were available for review.

Compound Quantitation and Reported Detection Limits

Raw data were not available for review to confirm quantitation and detection limits.

INORGANICS - SOIL/SEDIMENT

Metals and Cyanide

Holding Times

All holding times were within specified limits.

Calibration

Initial and continuing calibrations were within limits. There was not evidence of a mid-range cyanide standard being distilled and analyzed. There were no raw data received to confirm. Positive results for cyanide will be qualified as estimated.

Blanks

Most of the blank values were within QAPP specified limits. SDG E46430 has some nickel contaminants at low levels in a blank. Based on blank values before and after the contaminated blank, this seems to be an anomaly and does not affect overall data quality. Throughout all the samples there were many blank values with negative response values. The associated duplicates and spikes indicate that data quality were not adversely impacted, but this is a potential problem that the laboratory should monitor closely to ensure their data quality.

ICP Interference Check Sample

All check sample results were within acceptable limits.

Laboratory Control Sample

All laboratory control samples results were within QAPP specified limits.

Duplicate Sample

Duplicate analyses were within control limits except for the following sample groups:

SDG E46245	Aluminum
	Chromium
	Zinc
SDG E46658	Chromium

Sample results associated with the above groups should be qualified as estimated.

Matrix Spike Sample

Samples that failed matrix spike criteria were correctly flagged for the failure. Samples analyzed for aluminum were greater than four (4) times the spike levels and thus were not spiked. The following are metals that failed spike recovery and associated Sample delivery groups (SDGs):

<u>Antimony</u>	<u>Chromium</u>	<u>Copper</u>	<u>Nickel</u>	<u>Silver</u>	<u>Selenium</u>	<u>Zinc</u>	
E46245	E46430	E46245	E46692	E46430	E46245		E46430
	E46350	E47595	E46350	E46810	E46350		
	E46245		E46589				
	E46350		E47595				
			E46245				
			E46350				
			E46904				
			E48012				
			E46658				
			E46430				

Data associated with the above samples and SDGs are flagged as estimated values. Applicable post-digestion spikes were performed. Data cannot be validated on post-digestion spikes alone. All other sample matrix spikes were within limits.

Furnace Atomic Absorption QC

Four elements: lead, arsenic, selenium, and thallium were analyzed by graphite furnace AA. The samples for analyses by furnace were in SDG E47592 and E46430. The raw data was not available for complete Furnace QC. Existing data available for review indicate that the laboratory followed correct procedure, and analytical results not within control limits are qualified as estimated. The following are sample analytes that are estimated values:

<u>Sample</u>	<u>Estimated Analyte ("J")</u>
G3/H4-2	Se
I4-2	Se, Pb, As
G4-2	Se
OG2-0	Se, Pb, As
BG2-0	Se
BG3-1	Se
H4/I5-2	Pb
OG4-0	Pb
BG3-0	Pb
H3/I4-2	Se
BG4-0	Se, Pb
BG4-1	Se
L4-0	Se
TP2-0	Se
TP7-0	Se
TP8-1	Se, Th

Most of these samples are below detectable values. Therefore, data are quantitatively usable.

ICP Serial Dilution

Analytical data was correctly qualified as estimated on the following SDGs:

<u>SDG</u>	<u>Estimated Analyte ("J")</u>
E46658	Al
E46350	Al
E46430	Ca, Cu, Fe
E46472	Al

All other samples were within specified limits.

Sample Result Verification

Raw data were not available to perform the complete result verification. Verification from reported data indicate results are in compliance with what has generally been stated in the RI/FS.

Field Duplicates

Calculation of relative percent difference on field duplicates indicates a good degree of precision. A few results were outside limits but with no pattern or frequency to adversely affect data usability.

INORGANICS - GROUND WATER, SURFACE WATER

Metals and Cyanide

Holding Times

Holding times for metal analytes were within QAPP specified limits. Cyanide holding times from the QAPP were twelve (12) days instead of the usual regulatory holding time of fourteen (14) days. This resulted in some holding time exceedances, but these were not determined to have affected data quality. The laboratory apparently was unaware of the QAPP holding time limits.

Calibration

Initial and continuing calibration were within QAPP specified limits except for the absence of a cyanide mid-range standard. Results for cyanide are at such a low level that the mid-range standard will not affect evaluation. Raw data were not available to calculate correlation coefficients. Associated data are usable.

Blanks

The calibration blanks indicate through the presence of many negative values a potential problem with analytical techniques. The field blanks were generally without contamination. Some analytes were not qualified properly. The presence of a compound in the blank should result in qualifying the data at a higher detection limit. The following table gives the correct reporting values for various sample analytes.

BLANK CORRECTED REPORTING VALUES PER ANALYTE

ANALYTE	SDG	SAMPLE	PREVIOUS	CORRECTED	5X BLANK
Zinc	E49696	EW1	8.00 J	8.00 UJ	44.5
Chromium	E48379	BP4	9.30 J	9.30 UJ	50
Chromium	E48379	TP11	28.50 J	28.50 UJ	50
Chromium	E48379	SW5	21.10 J	21.10 UJ	50
Chromium	E48379	SW8	12.80 J	12.80 UJ	50
Chromium	E48379	SW2	30.20 J	30.20 UJ	50
Chromium	E48379	IW1	20.70 J	20.70 UJ	50
Chromium	E48379	IW3	16.00 J	16.00 UJ	50
Copper	E48379	TP11	13.00 J	13.00 UJ	59.5
Zinc	E48379	TP11	6.70 J	6.70 UJ	72.5
Copper	E48376	BP1	19.50 J	19.50 UJ	102.5
Copper	E48376	TP10	21.40 J	21.40 UJ	102.5
Zinc	E48376	BP1	11.80 J	11.80 UJ	88
Zinc	E42376	WL1	9.40 J	9.40 UJ	88
Zinc	E48376	TP10	15.70 J	15.70 UJ	88
Zinc	E48376	TP1	13.10 J	13.10 UJ	88
Zinc	E48376	SW19	7.20 J	7.20 UJ	88
Chromium	E48376	SW20	9.20 J	9.20 UJ	37.5
Copper	E49131	SW10	33.80	33.80 UJ	75

* This is 5 times the highest associated blank result.

ICP Interference Check Sample

All interference check sample results are within limits.

Laboratory Control Sample

Laboratory control sample data were within acceptance limits.

Duplicate Samples

Duplicate chromium analysis on SDG E48379 was out of control. Since correction of sample result by blank had raised the detection limit, this was not determined to significantly affect data quality. All other duplicate analyses were within acceptable limits.

Matrix Spike Sample

All matrix spike results were in control except for the following:

- SDG E48376 Cu, Ag: Copper post-digest spike was run. Copper results are flagged as estimated. Silver requires no action.
- SDG E49131 Ag: Silver requires no action.

No other qualifications are necessary on matrix spike data.

Furnace Atomic Absorption (QC)

SDG E48379 was the only group of water samples requiring furnace analysis. Raw data were unavailable to perform a complete review of the furnace AA QC. From submitted information, the proper qualifying of various sample results did occur. There were QC failures on spike percent recovery for thallium, arsenic, and selenium. Affected results were so indicated and should be considered estimated values.

SPIKE PERCENT RECOVERY FAILURES
(REQUIRED 85-115%)

SAMPLE	THALLIUM	ARSENIC	SELENIUM
HMW-TP2	69%	-	-
HMW-TP7	64.5%	-	-
HMW-TP11	83.5%	-	-
HMW-SW5	40.5%	63.0%	71%
HMW-SW8	44%	71.5%	69%
HMW-SW2	-	64.5%	81%
HMW-IW1	64%	64.5%	72%
HMW-IW3	79.5%	59.5%	-

ICP Serial Dilution

Serial dilution analyses were within specified limits.

Sample Result Verification

Raw data were not available to perform a complete review of sample quantitations.

Field Duplicates

Field duplicates available for review indicate good agreement with original sample. No qualification of results upon field duplicates is required.

Miscellaneous Parameters

Ground Water, Surface Water, Soil and Sediment

Hexavalent Chromium, Nitrogenous Compounds

Holding Times

Unable to confirm proper holding times due to absence of information from data package.

Calibration

Calibration results were within acceptance limits.

Blanks

Method and field blanks had no contaminants.

Matrix Spike

Matrix spike results were within acceptable ranges.

Duplicates

Duplicates were within acceptable limits.

Laboratory Control Sample

Laboratory control sample results were within specified limits.

GLOSSARY OF TERMS

Analytical spike - the furnace post-digestion spike. The addition of a known amount of standard after digestion.

4-Bromofluorobenzene (BFB) - compound chosen to establish mass spectral instrument performance for volatile analyses.

Continuing calibration (inorganic) - analytical standard run every 10 analytical samples or every 2 hours to verify calibration of analytical system.

Continuing calibration (organic) - analytical standard run every 12 hours to verify the calibration of the GC/MS system.

Control limits - a range within which specified measurement results must fall to be compliant.

Decafluorotriphenylphosphine (DFTPP) - compound chosen to establish mass spectral instrument performance for semivolatile analysis.

Duplicate - a second aliquot of a sample that is treated the same as the original sample in order to determine the precision of the method.

Field blank - any sample submitted from the field identified as a blank.

Holding time - the elapsed time expressed in days from the date of receipt of the sample by the laboratory until the date of its analysis or preparation for analysis. Often has regulatory limitations.

Inductively Coupled Plasma (ICP) - a technique for the simultaneous or sequential multi-element determination of elements in solution.

Interferents - substances which affect the analysis for the element of interest.

GLOSSARY OF TERMS (Cont'd)

Internal standards - in-house compounds added at a known concentration.

Laboratory control sample - a control sample of known composition analyzed using the same sample preparation, reagents, and analytical methods employed for the samples.

Matrix - the predominate material of which the sample to be analyzed is composed.

Matrix spike - aliquot of a sample fortified (spiked) with known quantities of specific compounds and subjected to the entire procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery.

Matrix spike duplicate - a second aliquot of the same matrix as the matrix spike that is spiked in order to determine the precision of the method.

Recovery - a determination of the accuracy of the analytical procedure made by comparing measured values for a fortified sample against the known spike values.

Relative response factor (RRF) - a measure of the relative mass spectral response of an analyte compared to its internal standard.

Sample delivery group (SDG) - a unit used to identify a group of samples for delivery, usually a group of 20 or fewer.

Semivolatile compounds - compounds amenable to analysis by extraction of the sample with an organic acid. Base/Neutral/Acid (BNA) compounds.

Serial dilution - the dilution of a sample by a factor of 5. Serial dilution may reflect the influence of interferents.

GLOSSARY OF TERMS (Cont'd)

Surrogates - for semivolatiles and pesticides/Arochlors, compounds added to every blank, sample, matrix spike, and standard; used to evaluate analytical efficiency by measuring recovery.

Target compound list (TCL) - a list of compounds designated by the statement of work (work plan) for analysis.

Tentatively identified compounds (TICs) - compounds detected in samples that are not target compounds, internal standards, system monitoring compounds, or surrogates.

Volatile compounds - compounds amenable to analysis by the purge and trap technique.

PART 3: PROPOSED MONITORING WELL SAMPLING

**FINAL TECHNICAL MEMORANDUM
HI-MILL MANUFACTURING
HIGHLAND, MICHIGAN**

June 1991

Prepared for:

**Hi-Mill Manufacturing Company
1704 Highland Road
Highland, MI 48031**

Prepared by:

**Geraghty & Miller, Inc.
50 West Big Beaver Road, Suite 245
Troy, Michigan 48084
(MI135.01)**

PART 3: PROPOSED MONITORING WELL SAMPLING

This section discusses the second round of monitoring well sampling which was proposed in Techna's approved work plan of the Hi-Mill facility. The discussion below emphasizes recommended changes to the approved work plan.

The approved ground-water sampling plan was reviewed and determined to be consistent with standard Geraghty & Miller procedures for CERCLA sites. There are no recommended changes to the ground-water sampling plan.

Geraghty & Miller recommends that all the existing SW wells be sampled a second time except for SW-2, SW-12, SW-15, SW-17, SW-18, and SW-19. SW-2 is located in a different depositional environment than the other shallow wells. Due to problems with the construction of SW-12 and SW-15, Geraghty & Miller does not believe representative samples can be collected from these wells. Because SW-17, SW-18, and SW-19 are upgradient intermediate wells, Geraghty & Miller does not believe they need to be sampled. The two additional shallow wells proposed for construction northwest of the Hi-Mill facility should also be sampled. The shallow wells recommended for sampling are the same wells used for developing the potentiometric map around the Hi-Mill facility.

Geraghty & Miller recommends that only IW-1, IW-2, and IW-3; and IW-5 in the intermediate aquifer be sampled a second time. Geraghty & Miller does not recommend sampling of IW-4, SW-17, SW-18, and SW-19 because they are additional intermediate wells upgradient of the shallow water contamination. The two intermediate wells proposed for construction northwest of the Hi-Mill facility should also be sampled.

Geraghty & Miller recommends that only deep well DW-1 be sampled. There is no evidence from the results of the first round of sampling that any contamination has penetrated the deep aquifer. Therefore, sampling of DW-2 and DW-3 is not believed to be necessary. DW-1 is recommended for sampling because it is the most likely route of recharge from the intermediate aquifer because the clay above it thins to the north and because a formation collapse occurred during its construction.

Geraghty & Miller proposes to have these monitoring well samples analyzed for field parameters (pH, temperature, specific conductance), a dissolved metals short list (aluminum, chromium, copper, nickel, zinc) and VOC. Table 1 lists the monitoring wells targeted for sampling. Table 2 lists the chemical parameters to be analyzed in each sample. No VOCs are proposed for analysis in the intermediate and deep wells because none were detected in the first round of sampling.

Table 1

Monitoring Wells Included in the Second Round of Ground-Water Sampling

SW-1	IW-1
SW-3	IW-2
SW-4	IW-3
SW-5	IW-5
SW-6	IW-6 (proposed)
SW-7	IW-7 (proposed)
SW-8	
SW-9A	DW-1
SW-10	
SW-11	
SW-13	
SW-14	
SW-20	
SW-21	
SW-22	
SW-23 (proposed)	
SW-24 (proposed)	

* No VOCs analysis

Table 2

Chemical Analytes for Monitoring Well Samples

pH	Acetone
Temperature	Benzene
Specific Conductance	Bromodichloromethane
	Bromoform
Aluminum	2-Butanone
Chromium	Carbon disulfide
Copper	Carbon tetrachloride
Nickel	Chlorobenzene
Zinc	Chloroethane
	2-Chloroethyl vinyl ether
	Chloroform
	Dibromochloromethane
	1, 1-Dichloroethane
	1, 2-Dichloroethane
	1, 1-Dichloroethene
	1, 2-Dichloroethene (Total)
	1, 2-Dichloropropane
	cis-1, 3-Dichloropropene
	trans-1, 3-Dichloropropene
	Ethylbenzene
	2-Hexanone
	Methylene chloride
	4-Methyl-2-pentanone
	Styrene
	1,1,2,2-Tetrachloroethane
	Tetrachloroethene
	Toluene
	1,1,1-Trichloromethane
	1,1,2-Trichloromethane
	Trichloroethene
	Vinyl acetate
	Vinyl chloride
	Xylene (Total)

PART 4: ECOLOGIC INVENTORY/ASSESSMENT

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PART 4: ECOLOGIC INVENTORY/ASSESSMENT

The Hi-Mill facility is located southeast of M-59 approximately 1.5 miles east of Highland, Michigan. The site covers approximately 4.5 acres and is bounded on the northeast, southeast, and southwest by the Highland State Recreation Area. Target Pond is situated immediately to the northeast of the site and Waterbury Lake is to the southeast. Target Pond and Waterbury Lake were included in the National Wetlands Inventory completed by the U.S. Fish and Wildlife Service. The wetland flora associated with Target Pond is contiguous with the northeast and southeast sides of the Hi-Mill property.

Recent guidance (Warren- Hicks, et al., 1989) has stated that three types of information are needed to establish a causal relationship between releases from hazardous waste sites and ecologic effects. First, chemical analyses of the appropriate media are necessary to establish the presence, concentration, and variability of specific toxic chemicals. Second, ecologic surveys are necessary to establish that adverse ecologic effects have occurred. And finally, toxicity tests (i.e., bioassays) are necessary to establish a link between the adverse ecologic effects and the toxicity of the chemical release. Without all three types of data, other potential causes of the observed effects unrelated to the chemical release, such as habitat alterations and natural variability, cannot be eliminated.

The Draft RI report (Techna, 1990) indicates that elevated concentrations (i.e., exceeding background concentrations) of selected metals, particularly aluminum, chromium and copper, are present in surficial soil and sediment samples collected from the northeast and southeast portions of the Hi-Mill facility. These concentrations of metals were not normalized for differences in total organic carbon (TOC), grain size distribution, or pH. The principal goal of this ecologic assessment will be to determine if these concentrations of selected metals are of sufficient magnitude to adversely impact the flora and/or fauna of the area and to actually measure ecologic impairment if it has occurred.

Considering the three requisite types of information needed to establish a link between a chemical release and ecological impact, a phased approach to the work is proposed with some of the activities scheduled for fall of 1990. Subsequent work is scheduled for the winter of

1990-91 and spring of 1991 and is partially contingent on the results of the work completed in the fall of 1990. This work may be divided into three phases as listed below:

- ◆ Sediment bioassays of samples from the Target Pond in the fall of 1990;
- ◆ Literature review of flora and fauna in the winter of 1990-1991;
- ◆ Floral and faunal field work in the spring of 1991;

Sediment Bioassays

Bioassays, in which organisms are placed in contact with sediment and biological effects are recorded (e.g., survival, growth, emergence), provide a direct assessment of toxic effects related to suspected chemical releases. A bioassay-based approach builds upon initial chemical results because:

- ◆ Water quality criteria are available for relatively few chemicals, and soil and sediment quality criteria are not yet available for any chemical;
- ◆ Water, soil, and sediment quality criteria do not account for additive, synergistic, or antagonistic interactions among chemicals in complex mixtures;
- ◆ Bioassays measure the aggregate toxicity of all constituents in a complex mixture, including additive, synergistic, or antagonistic interactions;
- ◆ Chemical analysis for complex mixtures, especially for organic compounds, can be more expensive than bioassays;
- ◆ The specific chemicals analyzed for in complex mixtures may not include toxic chemicals actually present;
- ◆ It is not always clear from the chemical data which chemicals are causing toxicity in a complex sample;

- ◆ The bio-availability of toxic chemicals is evaluated with bioassays but not with chemical analyses; therefore, chemical data may over- or under-estimate the toxicities of single chemicals.

A sediment bioassay will be conducted in the fall of 1990 to determine if the sediments of Target Pond exhibit biological toxicity. Bioassays of the water from Target Pond will not be conducted because the concentrations of selected metals are below ambient water quality criteria established by the USEPA (1986) and the Michigan Department of Natural Resources (MDNR). Kenaga, 1984, reported that Daphnia were very abundant in Target Pond. Daphnia is one of the more sensitive freshwater organisms (Gauss et al., 1985).

Prior information from the analysis of surficial soil and sediment samples indicates that two areas of elevated concentrations exist at the Hi-Mill facility. One area is near the location of sediment sample HMS-TP04 and the second is near the location of sediment samples HMS-TP08 and HMS-TP11. Three surface sediment samples will be collected in the fall of 1990 to determine if the sediments exhibit toxic properties and to assist in the definition of the limits of the toxic effects (if they occur) within Target Pond. One sample will be collected from HMS-TP04; the second sample will be collected between locations HMS-TP08 and HMS-TP11; and the third sample will be collected from location HMS-TP10, an area where the concentrations of selected metals is relatively low. These samples will be subjected to the standard bioassay test for whole sediment conducted by Analytical Bio-Chemistry Laboratories, Inc., Columbia, Missouri. The chronic toxicity tests will be conducted for 10 days with survival and sublethal effects (e.g. reduced growth) being assessed.

If the sediment does not exhibit toxic effects, then additional sediment bioassays, characterization of the concentration of selected metals in plant tissue, and benthic macroinvertebrate sampling will not be conducted. If the sediment is toxic at locations HMS-TP04 and between HMS-TP08 and HMS-TP11, then additional sampling and analysis will be conducted to estimate the extent of the toxic sediment. This could involve additional sediment bioassays, assessing to concentrations of metals and associated levels of TOC, grain size distribution, and pH or using other analytical techniques on sediment samples collected from the southwestern margin of Target Pond. Additional geological/hydrogeological/chemical work may also be proposed if the sediment is determined to be toxic.

Literature Review

The literature review will include the following tasks and procedures performed during the winter of 1990-1991:

- 1) Identification of major floral communities. A literature review will be conducted to determine flora and floral communities expected to be present on site and immediately surrounding the site. A preliminary evaluation of existing maps and soil reports to determine drainage patterns, soils, mapped wetlands, and topographic features will be conducted prior to field work.
- 2) Characterization of animal species using site and adjacent areas as habitat. This will be accomplished initially through a literature search of species known to occur in the area.
- 3) Evaluation of potential stresses on the on-site and adjacent ecological systems not related to site contaminants. This evaluation initially will consist of a review of historical information such as aerial photographs and climatic data related to the site.
- 4) Identification of terrestrial and aquatic reference areas having similar characteristics to the site, but that are not impacted by site contaminants. Reference areas will be identified through a preliminary review of existing maps, soil reports and aerial photos of the site, and an evaluation of similar areas with comparable characteristics.
- 5) Identification of potentially sensitive and/or significant ecologic resources on or associated with the site, based on the ecologic inventory of the site. Any rare or endangered species known to occur on site will be included.
- 6) Research on toxicity of metals in plants. Plants can accumulate elevated levels of metals which may be deleterious. In an effort to assess the potential for the vegetation near the Hi-Mill site to be adversely impacted by metals, a literature

review will be completed this winter. Information will be obtained on the direct impacts of selected metals on plants and the potential for the plants (if they accumulate metals) to serve as pathways to adversely impact herbivorous aquatic and terrestrial fauna. The review will also concentrate on determining the most appropriate portion of the plant (e.g., leaves, bark, root) to sample and analyze for selected metals. This task should assist in determining if the dead trees observed at the site may have been killed by the metals in the soil and/or sediment.

Field Work

Field work associated with inventory/assessment of the flora and fauna will occur in the spring of 1991. The exact extent of this field work will depend on the results of the sediment bioassays and literature review. A discussion of typical tasks that might be expected to occur follows:

- 1) Characterization of vegetative species within each major floral community. The field evaluation will consist of observation and identification of vegetative species. If appropriate, a determination of community composition using a scientifically accepted vegetative sampling method will be conducted.
- 2) Characterization of animal species. Fauna surveys are an effective way to establish that ecological effects have occurred. Indigenous fauna serve as continuous monitors of environmental quality by integrating contaminant exposure if it has occurred. Field work will include observations of bird nests, tracks, songs, casing, etc. A benthic macroinvertebrate survey of Target Pond will be conducted in the spring if the sediment bioassays indicate toxicity or the literature review reveals that concentrations of metals observed in the soil or sediment could adversely impact the flora or herbivorous fauna.

The benthic community near HMS-TP04, between HMS-TP08 and HMS-TP11, and HMS-TP10 will be quantitatively sampled and the different taxa identified and enumerated. Structural endpoints such as species richness, evenness, species

diversity, relative abundance, indicator species, and guild structure will be determined.

- 3) Evaluation of potential ecologic stresses. Field work will consist of observation of physical site conditions such as topography and man-made features.
- 4) Identification of terrestrial and aquatic reference areas. Reference areas preliminarily reviewed in the literature will be field checked to confirm similarity to site characteristics. Field checks will consist of observations of plant composition and topographic features. If appropriate, soil sampling and classification will be performed.
- 5) Identification of potentially sensitive and/or significant ecological resources. Any rare or endangered species observed during the field work will be noted.

Reports

A report summarizing the results of the sediment bioassays and literature review will be prepared during the winter of 1990-1991. The report will recommend the nature and extent of field work to be performed in the spring of 1991. It will also include a proposed work plan for this field work.

A report presenting the results of the field work will be submitted in the late spring of 1991. The conclusions of this report will be incorporated in the Baseline Risk Assessment.

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PART 5: BASELINE RISK ASSESSMENT REVISIONS

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PART 5 BASELINE RISK ASSESSMENT REVISIONS

FINAL TECHNICAL MEMORANDUM HI-MILL MANUFACTURING COMPANY

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PART 5: BASELINE RISK ASSESSMENT REVISIONS SUMMARY

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1. Exposure Dose and Risk Equations for Soil Exposure, Hi-Mill, Manufacturing Company, Highland, Michigan.
2. Exposure Dose and Risk Equations for Potable Ground Water Exposure, Hi-Mill, Manufacturing Company, Highland, Michigan.
3. Exposure Dose and Risk Equations for Swimming Exposure, Hi-Mill Manufacturing Company, Highland, Michigan.
4. Exposure Dose and Risk Equations for Sediment Exposure, Hi-Mill Manufacturing Company, Highland, Michigan.
5. Exposure Dose and Risk Equation for Fish Ingestion Exposure, Hi-Mill Manufacturing Company, Highland, Michigan.
6. Reference Doses and Cancer Potency Factors, Hi-Mill Manufacturing Company, Highland, Michigan.

FIGURES

1. Conceptual Site Model for Potential Exposure, Hi-Mill Manufacturing Facility, Highland, Michigan.

PART 5: BASELINE RISK ASSESSMENT REVISIONS

The intent of the revisions to the Baseline Risk Assessment is to strengthen the presentation of the data, modify sections that may deviate from current USEPA guidance, provide quality assurance on all quantified risk levels, and to incorporate new information associated with the RI data collection and ecologic inventory.

- ◆ The section describing the nature and extent of contamination will be re-written summarizing the validated data. Quantitative data for each constituent and media will be presented as: (1) frequency of detects; (2) range of detects; and (3) 95 percent upper confidence limit (UCL) of the arithmetic average concentration detected. The 95 percent UCL will be identified as the reasonable maximum exposure (RME) exposure point concentrations that will be used in calculating exposure dose levels.

A site conceptual model has been prepared identifying sources, release mechanisms, exposure points, exposure routes, and generalized receptors (Figure 1). Exposure pathways that have been identified for quantification of exposure risks are:

1. Inhalation of fugitive dust/(volatiles) (associated with surficial soils);
2. Dermal contact and ingestion of surficial soils;
3. Ingestion of potable ground water in the future;
4. Swimming;
5. Dermal contact and ingestion of wetlands sediments; and
6. Ingestion of fish.

Exposure dose equations and associated parameters for these exposure pathways are listed in Tables 1 through 5. Sensitive receptors are assumed to be adult and child, future hypothetical residents, and visitors to the wetlands and lake.

- ◆ The risk characterization section will quantify the individual constituent excess lifetime cancer risks and hazard quotients using the calculated exposure doses. Summations of excess lifetime cancer risks and hazard quotients (hazard indices) will be made for each exposure pathway and for a total site risk. Toxicity endpoints (reference doses and cancer slope factors) to be used in the calculation of risks are listed in Table 6.
- ◆ A section on the uncertainties associated with risk assessment methodology, in general, and assumptions specific to this site will be added to the report.

The section that assesses environmental risks will be modified to incorporate new data that have been collected. Results of the ecologic inventory conducted in October 1990 will be used to identify potential impacts to the wetlands and uncertainties in the hazard evaluation.

Upon completion of the revisions, the Baseline Risk Assessment for the Hi-Mill facility will be consistent with current USEPA guidelines. The RME (DEFINE) risk levels will be reflect conservative estimates of risks to public health or the environment under baseline conditions. These baseline risk levels can then be used in assessing the remedial alternatives in the Feasibility Study.

Table 1. Exposure Dose and Risk Equations for Soil Exposure, Hi-Mill Manufacturing Company, Highland, Michigan.

Equation Definition

$$ExD_o = \frac{C_s \times (SSA \times DA \times BAF \times SMF + IR) \times EP}{BW \times AP \times UC1}$$

$$ExD_i = \frac{C_s \times BR \times ED \times H \times PGV \times UC2 \times UC3 \times EP}{BW \times Kd \times W \times AP \times UC4} \quad (\text{vapors})$$

$$\text{or} \\ \frac{C_s \times SPM \times BR \times ED \times FIP \times EP}{BW \times AP \times UC1} \quad (\text{particulates})$$

$$HQ = \frac{ExD_o}{RfD_o} + \frac{ExD_i}{RfD_i}$$

$$CR = ExD_o \times csf_o + ExD_i \times csf_i$$

where:

- AP Averaging period (27,375 days/lifetime [75 years] for carcinogens; exposure period for threshold effects)(USEPA, 1989).
- BAF Bioavailability adjustment factor (constituent specific).
- BR Breathing rate (2.1 m³/hr: child; 1.3 m³/hr: adult)(USEPA, 1989).
- BW Body weight (16 kg: child; 70 kg: adult)(USEPA, 1989).
- CR Cancer risk.
- C_s Soil concentration (mg/kg).
- csf_o Cancer slope factor; oral (mg/kg/day)⁻¹.
- csf_i Cancer slope factor; inhalation (mg/kg/day)⁻¹.
- DA Dust adherence (0.51 mg/cm²-day)(DEP, 1989).
- ED Exposure duration (4 hrs/day: child; 2 hrs/day: adult).
- EP Exposure period (1,825 days/lifetime: child; 10,950 days/lifetime: adult).
- ExD_i Soil exposure dose-inhalation (mg/kg/day).
- ExD_o Soil exposure dose-oral and dermal (mg/kg/day).
- FIP Fraction inhaled particulates (0.125 [53 FR 148]).
- H Henry's Law Constant (atm·m³/mol) (constituent specific).
- HQ Hazard quotient.
- IR Ingestion rate (200 mg/day: child; 100 mg/day: adult) (USEPA, 1988).
- Kd Partition coefficient (cm³/g)(constituent specific).
- PGV Pore gas velocity (1.63 x 10⁻⁵ m/sec) (Hwang and Falco,1986).
- RfD_i Reference dose; inhalation (mg/kg/day).
- RfD_o Reference dose; oral (mg/kg/day).
- SPM Suspended particulate matter (0.075 mg/m³ [53 FR 148]).
- SSA Skin surface area exposed (1,800 cm²: child [face, lower arms, hands, and feet] 2,940 cm²: adult [short-sleeved open-necked shirt, pants and shoes with no hat or gloves])(USEPA, 1989a).
- UC1 Unit conversion 1 (10⁶ mg/kg).
- UC2 Unit conversion 2 (41 mol/atm·m³) (Hwang and Falco, 1986).
- UC3 Unit conversion 3 (10⁶ cm³/m³).
- UC4 Unit conversion 4 (10³ g/kg).
- W Wind speed (4.6 m/sec)(average wind speed at Detroit City Airport) (NOAA, 1974).

Table 2. Exposure Dose and Risk Equations for Potable Ground Water Exposure, Hi-Mill Manufacturing Company, Highland, Michigan.

Equation Definition

$$ExD = \frac{C_{gw} \times IR \times EP}{BW \times AP}$$

$$CR = ExD \times csf$$

$$HQ = ExD/RfD$$

where:

- AP Averaging period (27,375 days/lifetime: carcinogens; exposure period for threshold effects) (USEPA, 1989b).
BW Body weight (70-kg adult) (USEPA, 1989b).
csf Cancer slope factor (/mg/kg/day).
 C_{gw} Concentration in ground water (mg/L).
CR Excess lifetime cancer risk.
EF Exposure period (10,950 days/lifetime [30 year RME residence time]) (USEPA, 1989b).
ExD Exposure Dose (mg/kg-day).
HQ Hazard quotient.
IR Ingestion rate - drinking-water (2 liter/day: RME) (USEPA, 1989b).
RfD Reference dose (mg/kg/day) (USEPA, 1989a).
-

Table 3. Exposure Dose and Risk Equations for Swimming Exposure, Hi-Mill Manufacturing Company, Highland, Michigan .

Equation Definition

$$ExD = \frac{C_{sw} \times (SSA \times WF \times AF \times UC + IRW) \times ED \times EP}{BW \times AP}$$

$$CR = ExD \times csf$$

$$HQ = ExD/RfD$$

where:

AF	Absorption factor-dermal (0.10) (USEPA, 1984).
AP	Averaging period (27,375 days/lifetime: carcinogens; exposure period for threshold effects) (USEPA, 1989).
BW	Body weight (16-kg child [average for age 1 to 6 yrs] ; 70-kg adult) (USEPA, 1989).
csf	Cancer slope factor (/mg/kg/day).
C _{sw}	Concentration in surface water (mg/L).
CR	Excess lifetime cancer risk.
ED	Exposure duration (2.5 hrs/day).
EP	Exposure period (35 days/lifetime: child [7 days per year over 5 year period; 210 days/lifetime: adult [7 times per year over a 30 year residence period]])(USDOl, 1979; USEPA, 1989).
ExD	Exposure Dose (mg/kg-day).
HQ	Hazard quotient.
IRW	Ingestion rate - water (0.05 L/hr).
RfD	Reference dose (mg/kg/day).
SSA	Skin surface area exposed to water (7,200 cm ² child; 18,150 cm ² : adult) (USEPA, 1989).
UC	Unit conversion (10 ⁻⁶ L/mg).
WF	Water flux across the skin (0.5 mg/cm ² -hr) (USEPA, 1988).

Table 4. Exposure Dose and Risk Equations for Sediment Exposure, Hi-Mill Manufacturing Company, Highland, Michigan.

Equation Definition

$$ExD = \frac{C_s \times (SSA_s \times DA \times BAF + IRS) \times UC \times EF}{BW \times AP}$$

$$CR = ExD \times csf$$

$$HQ = ExD/RfD$$

where:

AP	Averaging period (27,375 days/lifetime: carcinogens; exposure period for threshold effects) (USEPA, 1989b).
BAF	Bioavailability factor-dermal (constituent specific).
BW	Body weight (16 kg: child; 70 kg: adult) (USEPA, 1989).
csf	Cancer slope factor (/mg/kg/day).
C _s	Concentration in ditch sediments (mg/kg).
CR	Excess lifetime cancer risk.
DA	Dust adherence (0.51 mg/cm ² -hr) (DEP, 1989).
EP	Exposure period (144 days/lifetime: child [24 times a year over a six year period]; 720 days/lifetime: adult [24 times a year over a 30 year residence period]).
ExD	Exposure Dose (mg/kg-day).
HQ	Hazard quotient.
IRS	Ingestion rate - sediments (200 mg/day: child; 100 mg/day: adult) (USEPA, 1988).
RfD	Reference dose (mg/kg/day).
SSA	Skin surface area exposed to sediments (1,800 cm ² : child [face, lower arms, hands, and feet]; 2,940 cm ² : adult [short-sleeved open-necked shirt, pants and shoes with no hat or gloves]) (USEPA, 1989b).
UC	Unit conversion (10 ⁻⁶ kg/mg).

Table 5. Exposure Dose and Risk Equations for Fish Ingestion Exposure, Hi-Mill Manufacturing Company, Highland, Michigan.

Equation Definition

$$\text{ExD} = \frac{C_{\text{sw}} \times \text{BCF} \times \text{IRF} \times \text{EP}}{\text{BW} \times \text{AP}}$$

$$\text{CR} = \text{ExD} \times \text{csf}$$

$$\text{HQ} = \text{ExD}/\text{RfD}$$

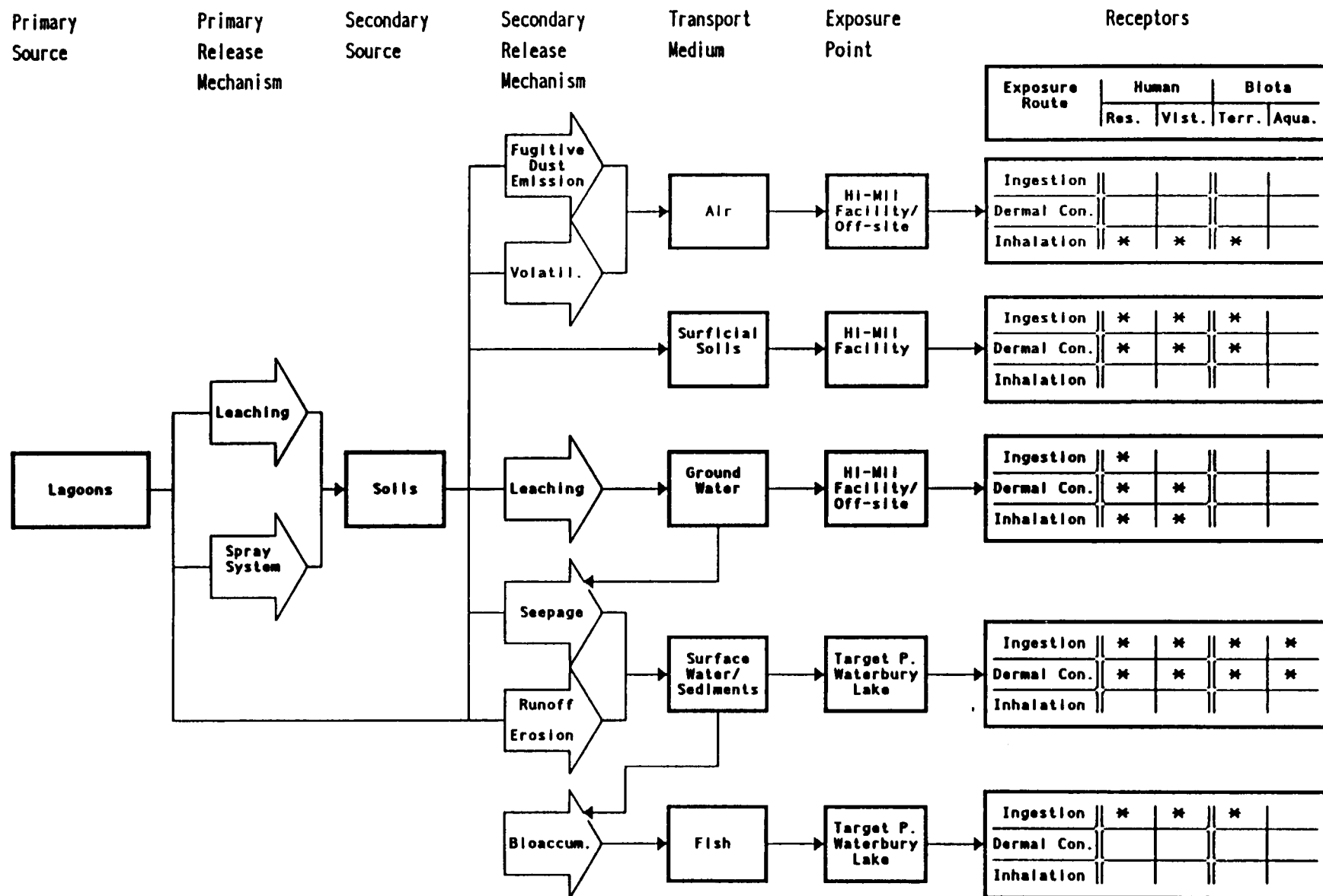
where:

AP	Averaging period (27,375 days/lifetime: carcinogens; Exposure period for threshold effects) (USEPA, 1989).
BCF	Bioconcentration factor (L/kg)(constituent specific)(USEPA, 1986).
BW	Body weight (70-kg adult)(USEPA, 1989).
csf	Cancer slope factor (/mg/kg/day).
C _{sw}	Concentration in surface water (mg/kg).
CR	Excess lifetime cancer risk.
EP	Exposure period (10,950 days/lifetime [30 year] RME).
ExD	Exposure Dose (mg/kg-day).
HQ	Hazard quotient.
IRF	Ingestion rate - fish (0.0065 kg/day) (USEPA, 1988b).
RfD	Reference dose (mg/kg/day).

Table 6. Reference Doses and Cancer Potency Factors, Hi-Mill Manufacturing, Highland, Michigan.

Constituents	RfD		CPF	
	Oral	Inhalation	Oral	Inhalation
<u>Inorganics</u>				
Aluminum	-	-	-	-
Chromium (III)	1.0	-	-	-
Chromium (VI)	0.005	-	-	41.
Copper	-	-	-	-
Lead	(pharmacokinetic lead model will be used)			
Nickel	0.02	-	-	0.84
Silver	-	-	-	-
Zinc	0.2	-	-	-
<u>Organics</u>				
Acetone	0.1	0.1	-	-
Chlorobenzene	0.02	0.005	-	-
1,2-Dichloroethene	0.02	0.55	-	-
Di(2-ethylhexyl) phthalate	0.02	-	0.014	-
Di-n-butyl phthalate	0.1	-	-	-
Ethylbenzene	0.1	0.3	-	-
Methylene chloride	-	-	0.0075	0.014
Methyl ethyl ketone	0.05	0.09	-	-
Tetrachloroethene	-	-	0.051	0.0033
Toluene	0.3	0.6	-	-
1,1,1-Trichloromethane	0.09	0.3	-	-
Trichloroethene	-	-	0.011	0.017
Vinyl chloride	-	-	2.3	0.295
Xylenes	2.0	0.3	-	-

RfD Reference Dose (mg/kg/day) (IRIS, 1990; HEAST (USEPA), 1989).
CPF Cancer potency factor (/mg/kg/day) (IRIS, 1990; HEAST (USEPA), 1989).



PART 6: DATA SUFFICIENCY ASSESSMENT

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(MI135.01)**

PART 6: DATA SUFFICIENCY ASSESSMENT

Previous sections of this memorandum have discussed technical aspects of the Draft RI such as geology, hydrogeology, laboratory data validation, proposed sampling activities, ecologic considerations, and risk assessment. This section summarizes Geraghty & Miller's assessment of the sufficiency of data collected during the RI from both a qualitative and quantitative viewpoint. It also summarizes recommendations for additional data collection to complete the RI.

Horizontal and Vertical Extent of Geologic Formations

For most areas, the soil borings performed at the Hi-Mill facility are adequate in number and quality of information to determine the horizontal and vertical extent of geologic formations in the study area. However, the area northwest of the Hi-Mill building requires two additional shallow and two additional intermediate soil borings to further define the geologic framework. The additional work is required because the hydraulic gradient in the intermediate aquifer slopes to the northwest and the area northwest of the Hi-Mill building may be downgradient from the contamination sources in the shallow water area.

Hydraulic Gradients

In general, the static water-level data at the Hi-Mill site are adequate to determine hydraulic gradients in the shallow water area and intermediate and deep aquifers. However, two portions of the shallow water area require additional data. The area northwest of the Hi-Mill building requires monitoring wells to establish the shallow water hydraulic gradient in this area. The second area is between Waterbury Lake and Target Pond. Geraghty & Miller proposes to place two shallow water piezometers in this area to determine if there is a hydraulic connection between the two surface-water bodies. New surface-water staff gauges should also be used because the old ones are either difficult to read or difficult to locate.

Horizontal and Vertical Extent of Contamination

The chemical laboratory data are generally sufficient to determine the horizontal and vertical extent of contamination in the soil and ground water. However, the area northwest

of the Hi-Mill building is downgradient of contamination sources in the intermediate aquifer and may be downgradient of the contamination sources in the shallow water area. Ground-water samples should be collected from two shallow and two intermediate monitoring wells and tested for chemical analytes as described in Part 3 of this memorandum to further delineate the extent of contamination in this area.

Geraghty & Miller also recommends that a soil-gas survey be conducted in the shallow water soils area. The soil-gas survey will be used to locate optimal sites for monitoring wells northwest of the Hi-Mill building. It will also allow delineation of "hot spots" located between the soil borings spaced at 60 ft intervals during RI activities and will allow more detailed definition of the extent of shallow contamination at the site.

Chemical Laboratory Data

Most of the chemical laboratory data from the RI is usable. However, 10 percent to 25 percent of the chemical data have been categorized as qualitative by Geraghty & Miller. A second round of monitoring well sampling as proposed in Part 3 of this memorandum is recommended. Collection of a second round of monitoring well samples will allow a comparison with the results of the first round of sampling. Geraghty & Miller proposes that a statistical analysis be performed to determine whether there is a significant difference between the first and second round of results. This statistical procedure can also be used to determine if there are significant differences in concentration between wells. The proposed statistical technique is analysis of variance (ANOVA), a method that can be used to perform multiple comparisons and that has been recommended by the USEPA for use with monitoring well data at landfills. The statistical analyses will be parametric when the data are all quantitative and non-parametric when the data are qualitative.

Geraghty & Miller proposes that both laboratories used previously in the RI, ENCOTEC and Wilson, be used in the second round of laboratory analyses. Using the same laboratories will eliminate an additional source of error in the statistical comparisons.

Chemical Analyses of Soil, Sediment, and Surface Water Samples

Chemical analyses of soil, sediment, and surface water samples in the RI are sufficient to identify elevated levels of contaminants. These existing data will be supplemented by the results of the soil-gas survey and sediment bioassays. These data are believed to be sufficient to identify potential alternative remedial measures for the site. If additional data are required to more precisely identify the extent of contamination in the soil, sediment, and surface water, that can be collected during the FS phase.

Ecological Considerations

Geraghty & Miller has reviewed the MDNR Ecological Survey and ecologic considerations discussed in the Draft RI report (Techna, 1990) and believes that the existing ecologic information on the study area is insufficient for use in an approvable CERCLA Risk Assessment. Geraghty & Miller recommends that an Ecologic Inventory/Assessment with the scope proposed in Part 4 of this memorandum be performed and that the results be incorporated into the Risk Assessment for the site. The Ecologic Inventory/Assessment will consist of sediment bioassays, a literature review, and field work.

Risk Assessment

Hi-Mill Manufacturing Company has requested that Geraghty & Miller proceed with revision of the Baseline Risk Assessment document submitted to the USEPA with the Draft Phase I RI report. The results of the Ecologic Inventory/Assessment will be incorporated into the revised Risk Assessment. Geraghty & Miller believes that the revised Risk Assessment may be of some assistance to the USEPA in its preparation of a Risk Assessment for the Hi-Mill facility.

PART 7: SCHEDULE OF DELIVERABLES

**FINAL TECHNICAL MEMORANDUM
HI-MILL MANUFACTURING
HIGHLAND, MICHIGAN**

June 1991

Prepared for:

**Hi-Mill Manufacturing Company
1704 Highland Road
Highland, MI 48031**

Prepared by:

**Geraghty & Miller, Inc.
50 West Big Beaver Road, Suite 245
Troy, Michigan 48084
(MI135.01)**

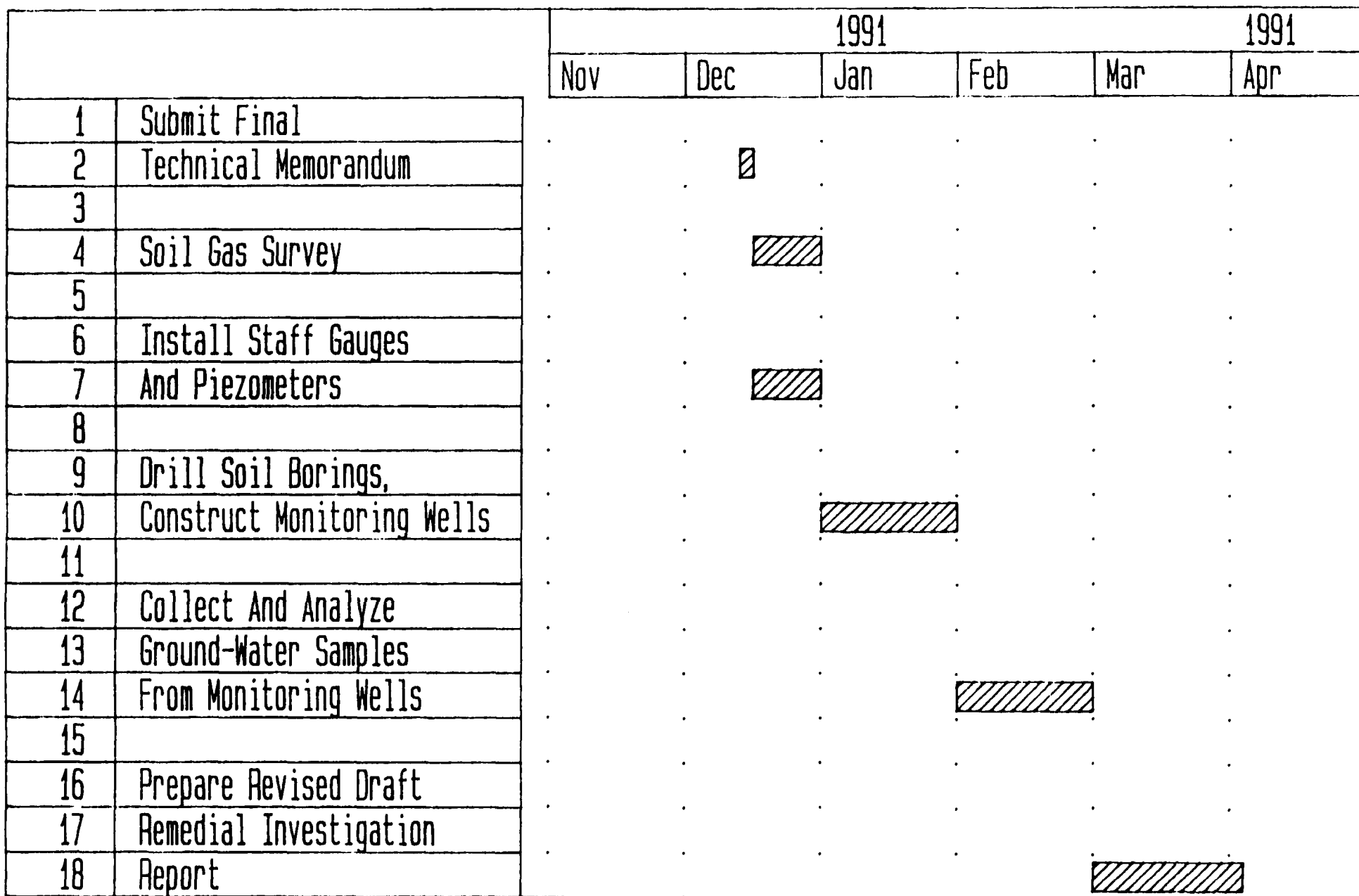
PART 7: SCHEDULE OF DELIVERABLES

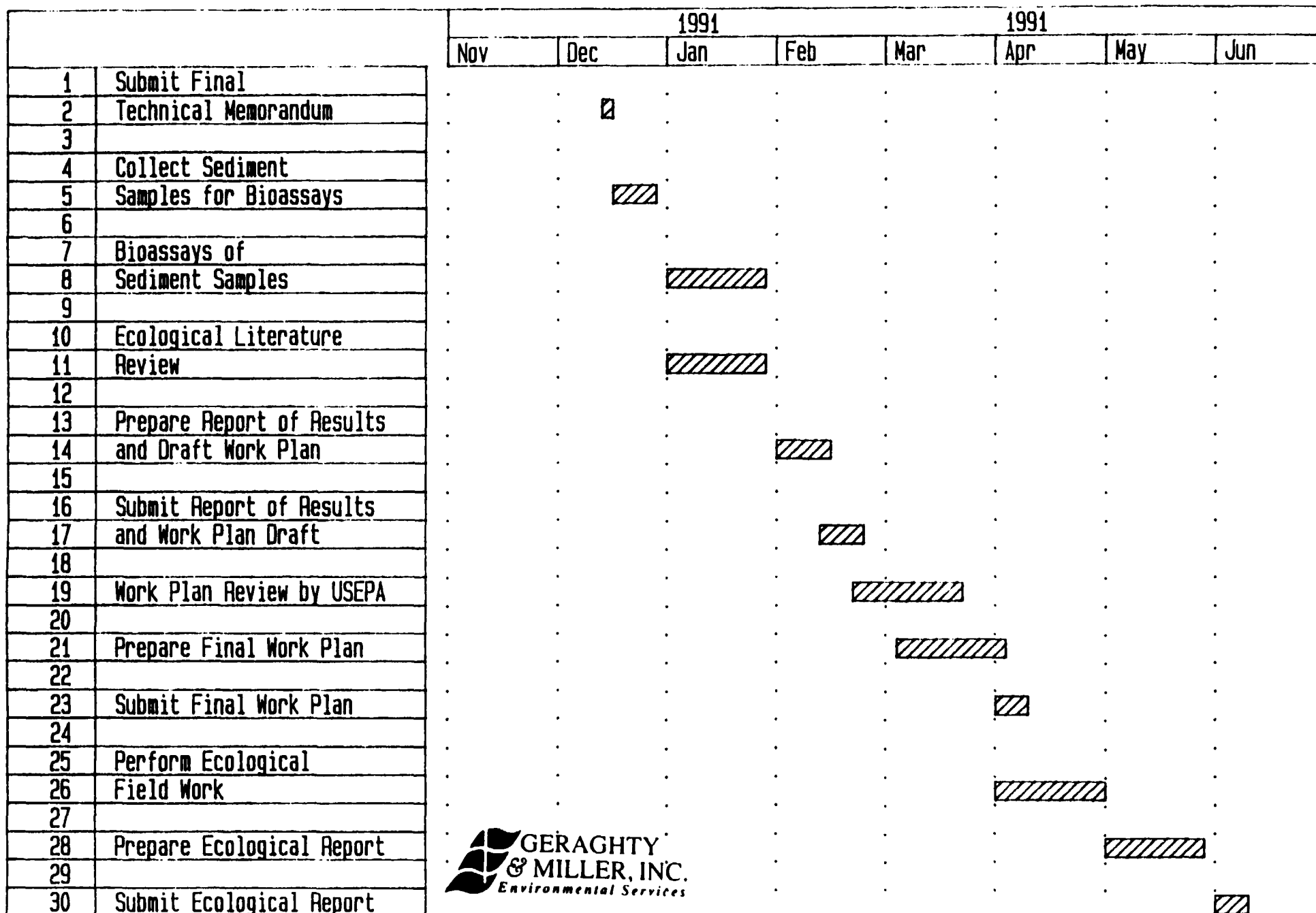
This section of the memorandum discusses the schedule of work to be completed prior to submission of the revised Draft RI report, (Techna, 1990). Table 1 presents the Geology/Hydrogeology/Chemical schedule of deliverables. Table 2 gives the Ecological Inventory/Assessment schedule of deliverables. Both schedules are contingent upon Geraghty & Miller receiving comments on the Draft Technical Memorandum from USEPA by December 1, 1990. If these comments are not received by December 1, 1990, Geraghty & Miller's ability to perform this work according to the proposed schedules may be compromised due to the difficulties of completing field work in winter weather conditions.

The Geology/Hydrogeology/Chemical schedule of deliverables assumes the Final Technical Memorandum will be submitted in mid-December of 1990. A soil-gas survey and the installation of staff gauges and piezometers will be completed in the second half of December. Drilling of soil borings and placement of monitoring wells will occur in January of 1991. Ground-water samples from monitoring wells will be collected and sent to laboratories for chemical analyses in February of 1991. During March of 1991, the revised Draft RI report (minus the Risk Assessment) will be prepared. It will be submitted to the USEPA on April 1, 1991.

The Ecological Inventory/Assessment schedule of deliverables also assumes the Final Technical Memorandum will be submitted in mid-December of 1990. Sediment sampling for the bioassays will be collected in the second half of December. The bioassays will be conducted during January of 1991, as well as the ecological literature review. A draft report of the results of the bioassays and the literature review and work plan for field activities will be prepared and submitted to the USEPA in mid-February of 1991. Allowing for a USEPA review period of 30 days, the final report will be submitted on April 1, 1991. The field work will be conducted during April of 1991, and a report of the field work will be prepared during May of 1991. The ecological field work report will be submitted on June 1, 1991.

The schedules proposed above were developed to deliver documents to the USEPA as quickly as feasible. There will be a two-month lag between the submission of the revised Draft RI report and the Ecological Inventory/Assessment report. Therefore, the Ecological Inventory/Assessment report will also contain an addendum to the revised Draft RI report. This addendum will address any changes to the Draft RI report necessitated by the conclusions of the Ecological Inventory/Assessment report.





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FIGURE 2
 ECOLOGICAL INVENTORY SCHEDULE
 HT-MT11 MANUFACTURING CO

TECHNICAL MEMORANDUM

ADDENDUM

**HI-MILL MANUFACTURING COMPANY
HIGHLAND, MICHIGAN**

January 1991

Prepared for:

**USEPA - Region 5
230 South Dearborn
Chicago, Illinois 60604**

and

**Hi-Mill Manufacturing Company
1704 Highland Road
Highland, Michigan 48031**

Prepared by:

**Geraghty & Miller, Inc.
50 West Big Beaver Road, Suite 145
Troy, Michigan 48064**

TECHNICAL MEMORANDUM

ADDENDUM

HI-MILL MANUFACTURING COMPANY
HIGHLAND, MICHIGAN

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AGENCY COMMENTS

PART 1 GEOLOGIC/HYDROGEOLOGIC SECTION HI-MILL DRAFT TECHNICAL MEMORANDUM

Below are comments concerning the Hi-Mill Manufacturing Draft Technical Memorandum from Karla Johnson of the USEPA (#1-#10), Murat Akyurek of Donohue & Associates (#11-#21) and Deborah Larson of the MDNR (22-#26). Each comment/concern from the agency is followed by a corresponding response from Geraghty & Miller, Inc.

#	page/paragraph	comment/response
1	2/2	C: Figure 7 shows 28 monitoring wells not 27 as stated in the text. R: Typographical error, revised text to read "28" wells.
2	2/6	C: The legend for Figure 10 misrepresents the brown clay layer. R: Revised the legend in Figure 10 to read correctly.
3	3/5	C: In the first sentence, Hydrogeologic Unit VI should be Hydrogeologic Unit VII. R: Typographical error, revised text to read "outwash sands" of Hydrogeologic Unit VI (not the "blue clay" of Hydrogeologic Unit VI)".
4	8/1	C: Figure 1 does not show that the topography west of the plant slopes toward the North Arm of Waterbury Lake, as stated. R: Typographical error, Plate I of the Technical Memorandum shows the westward slope of the topography .
5	10/2	C: Please place Tables 2A-2E and Tables 4A-4D in alphabetical order in the back of Part 1. R: Compilation error, Tables 2A-2E will be in alphabetical order in final report.
6a	10/3	C: Where were the background soil samples taken? R: Figure 6 shows the collection point for each of the 6 background soil samples. Table 3 identifies the 10 samples collected from the 6 different locations and the 7 samples that were used in the statistical analysis.

PAGE 2

USEPA HI-MILL DRAFT TECH MEMO COMMENTS
PART 1 - GEOLOGIC/HYDROGEOLOGIC SECTION

- 6b C: Why are 8 background sample locations referenced in the Tech Memo?
- R: Typographical error, the text was revised to indicate 10 samples were collected.
- 6c 10/3 C: Please include a legend or description for Figure 20.
- R: Legend for the figure is on the reverse side.
- 7a 11/1 C: There is a discrepancy between the chromium concentration stated in this paragraph (1620 ug/kg at 5.5 ft bsl) and that shown on Figure 23 (620 ug/kg).
- R: Typographical error, the chromium concentration in Figure 23 was corrected to read 1620 mg/kg.
- 7b 11/1 C: Explain what the #/# chromium concentrations on Figure 24 mean.
- R: The two adjacent numbers (#/#) represent 2 samples collected at the same location within the vertical depth range given on the figure.
- 8a 11/2 C: Expand discussion on VOCs in soil.
- R: Topic will be discussed in the G&M workplan.
- 8b 11/2 C: Include a figure that shows the sampling grids and locations for the VOC soil sampling and the concentrations found.
- R: Topic will be discussed in the G&M Workplan.
- 8c 11/2 C: Clarify the discussion on the soil gas survey. Are soil samples soil gas samples or soil samples.
- R: Topic will be discussed in the G&M Workplan.
- 9a 11/3 C: First sentence is unclear.
- R: Typographical error, the sentence now reads; Ground-water monitoring wells were sampled in accordance with the analytical summary provided in Table 2B.

PAGE 3

USEPA HI-MILL DRAFT TECH MEMO COMMENTS
PART 1 - GEOLOGIC/HYDROGEOLOGIC SECTION

- 9b 11/3 C: There are 21 wells listed as having been tested for VOCs not 20 as stated.
R: Typographical error, the text has been revised to read "21" wells.
- 9c 11/3 C: There are 28 wells shown on Figure 7 not 27 as stated.
R: Typographical error, the text has been revised to reflect 28 wells.
- 9d 11/3 C: Why isn't SW-13 shown on Figure 7?
R: Monitoring wells SW-13 and SW-16 were dry holes. However they are now both plotted on Figure 7 for future reference.
- 9e 11/3 C: Why isn't there SLM information in Table 4B for SW-2, SW-5, SW-8, SW-22, IW-1 when it was stated that all wells were samples for SLM.
R: Data was unavailable from lab but will be included in the RI report.
- 10 13/2 C: Figure 33 is missing.
R: Typographical error, Figure 34 was misnumbered and is now numbered as Figure 33.
- 11 4/1 C: Locations for the six staff gauges are shown in Figure 7 rather than Figure 6.
R: Typographical error, text has been changed to "Figure 7".
- 12 4/3 C: It is unclear how radial groundwater flow toward Target Pond suggests isolation from the surrounding watershed (surface water flow).
R: Shallow ground water in the immediate area of the site flows into Target Pond, which is isolated from the surrounding drainage channels.
- 13a 4/4 C: This discussion best included in Hydrogeology section.
R: This topic will be addressed in the Hydrogeology section.

PAGE 4

USEPA HI-MILL DRAFT TECH MEMO COMMENTS
PART 1 - GEOLOGIC/HYDROGEOLOGIC SECTION

13b 4/4 C: Figure 13 does not show a contour configuration suggesting ground-water flow from the 1,004-foot elevation in the pond to the 999.57-foot elevation in Waterbury Lake. These two elevations are not labeled on the figure. It is also unclear if SW-12, SW-15, and SG-2 were incorporated into Figure 13. If not, there appears to be limited basis for closing the 1,009-, 1,007- and 1,005-foot elevation contours. This representation suggests a mounding, with limited flow from Target Pond to Waterbury Lake.

R: Ground-water elevations and arrows representing ground water flow direction were added to Figure 13.

4/4 C: Techna's report referenced borings SW-13 and SW-16. These borings apparently did not encounter a shallow saturated zone. It is still unclear where the borings were located. Perhaps these boring locations and the lack of a shallow saturated zone can be used to further refine the contour configuration.

R: Boring locations of attempted monitoring wells SW-13 and SW-16 were added to Figure 7.

13d 4/5 C: Please correctly label the equipotential line within the legends of Figure 13 and 14. It is also suggested that these figure titles reflect consistency.

R: The legend description was corrected on both Figure 13 and 14. The title of Figure 14 changed to reflect consistency.

13e 4/5 C: Is the well integrity of SW-12 and SW-15 in question with regard to obtaining representable static water levels?

R: Static elevations were collected but not utilized in Oct. 31, 1990, representation.

14a 5/2 C: Is this truly a perched ground-water flow system, i.e. is there an unsaturated zone underlying this shallow saturated zone, or is this the true water table.

R: Boring logs SW-13 and SW-16 were dry holes indicating an unsaturated zone with depth.

14b 5/2 C: Omission of staff gauge measurements from the shallow potentiometric map should be clarified. Inclusion may be warranted.

R: Staff gauge measurements were omitted from the figure due to unreadable markings on the gauges.

PAGE 5

USEPA HI-MILL DRAFT TECH MEMO COMMENTS
PART 1 - GEOLOGIC/HYDROGEOLOGIC SECTION

- 15 6 C: This discussion needs to be integrated with the discussion on the surface water hydrology section which suggests radial ground-water flow toward Target Pond. Based on this discussion, Figures 13 and 14 should be consistent with Figure 15, in which case the top of page 5 becomes a weak discussion.
- R: Until the shallow surface water hydrology can be confirmed (with the use of piezometers), elevations from SW-12 and SW-15 will not be utilized.
- 16 6/2 C: This discussion suggests incompetent bentonite pellet seals within these wells.
- R: Possibly, additional field work will determine if that is the case.
- 16 6 C: This discussion is very good. It has important implications to the interpretation of shallow ground-water flow direction, and subsequently, to contaminant movement within the shallow ground-water system. Reference to Figure 16 should be added. Line of cross-section for Figure 16 should be shown.
- R: A reference to Figure 16 was made in the text.
- 17a 7/2 C: Ground water elevations ranged from a high of 1007.57 and 1000.23 rather than 107.57 and 100.25 as stated.
- R: Typographical error, the appropriate corrections have been made in text.
- 17b 7/2 C: The staff gauge elevations are not represented on the potentiometric map of the perched system (Figure 15). Also, ground-water flow direction arrows should be added to the figure.
- R: Ground-water flow arrows were added. Staff gauge elevations were not.
- 18 7/3 C: Plate I does not appear to be included.
- R: Compilation error, Plate I has been reproduced and is included in the report.
- 19a 7/4 C: The radial flow suggested by Figure 15 gives no indication of preferential northeast flow. How does radial flow to the southeast, south, and southwest relate to the general topographic gradient of the site and the slope of the clay surface? Clay lens surface? Or clay layer?
- R: The radial ground-water flow is in agreement with topographic gradient (Plate I). However the slope of clay surface is unknown in south and southwest.

PAGE 6

USEPA HI-MILL DRAFT TECH MEMO COMMENTS
PART 1 - GEOLOGIC/HYDROGEOLOGIC SECTION

- 19b C: Figure 17 has no scale, north arrow, or legend. This makes it difficult to concur with this paragraph.
- R: A "north" arrow has been added to Figure 17.
- 19c 7/4 C: Please specify "similar contour configurations" supporting preferential flow direction.
- R: If the TCE/DCE concentrations were plotted, the configuration would show a east to northeast flow.
- 20 8/2 C: This paragraph now introduces a preferential northwest flow direction. Based on preceding paragraphs, this now includes every direction. Please be specific, limit conclusions to data examined, and clarify this discussion. As drawn, Figure 15 does not suggest a northwest flow direction.
- R: Typographical error, the correction in the text now indicates a preferential "southwest" flow is possible. Figure 15 supports this interpretation.
- 21 8/3 C: Figure 18 has a mislabeled legend (equipotential lines and ground-water flow direction). It is also suggested that potentiometric surface maps be relabeled to reflect the aquifer or hydrogeologic unit (i.e., Intermediate Aquifer Potentiometric Surface rather than Intermediate Wells Potentiometric Map).
- R: The mistakes in Figure 18 have been corrected.
- 22 General C: It is the opinion of Michigan Department of Natural Resources (MDNR) that all of the existing monitoring wells at and around the Hi-Mill facility should be sampled a second time. We do not feel that one round of sampling is sufficient to characterize all ground-water conditions to the extent that any wells can be eliminated at this time. We do concur that, as a result of the analytical results from round one of well sampling, more of the monitoring wells, as proposed in the tech memo, should be sampled and analyzed for volatile organic compounds than were during the first round of sampling. However, none of the metals should be eliminated from the "short list" of metals.
- R: Topic will be discussed in the G&M workplan.
- 23 General C: Some confusion exists regarding nickel concentrations in the water and soil at Hi-Mill. The draft RI report submitted by Techna Corporation indicated significant concentrations of nickel in some samples. However, some time after the initial submittal, Techna submitted a packet of information indicating that nickel was not a problem on the site. It appears from the Geraghty Tech Memo that Geraghty is not aware of the subsequent submittal from Techna. This issue requires some clarification.

PAGE 7

USEPA HI-MILL DRAFT TECH MEMO COMMENTS
PART 1 - GEOLOGIC/HYDROGEOLOGIC SECTION

R: Initial "significant concentrations" of nickel were caused by calibration drift in the laboratory instrumentation. Samples were re-run after detecting the error.

- 24 General C: MDNR does concur that additional wells are needed northwest of the plant and that additional information defining the relationship between the target pond and Waterbury Lake is needed. We concur with Geraghty's proposals for addressing these needs.

R: Topic will be discussed in the G&M workplan.

- 25 General C: I am also concerned with the statement in paragraph one on page 3 of the executive summary where Geraghty discusses "hot spots" of metals in the sediments of the Target Pond. Perhaps confusion is a result of "directional interpretation" on the parts of author and myself, but I do not concur with the author that the "hot spots" are located in the east and northeast corner of the pond. The concentrations of some of the metals are very elevated throughout the pond, but if one were to characterize particular areas as specific "hot spots" I interpret these areas to be along the west and northwest sides of the pond.

R: The metal concentrations are being reviewed with discussions presented in the G&M workplan and RI.

- 26 General C: In summary, with the above exceptions and concerns, MDNR feels the proposals submitted by Geraghty & Miller are generally appropriate.

R: No response required.

AGENCY COMMENTS

PART 2 ANALYTICAL LABORATORY DATA VALIDATION SECTION HI-MILL DRAFT TECHNICAL MEMORANDUM

Below are comments concerning the Laboratory Data Validation Section of the Hi-Mill Manufacturing Draft Technical Memorandum from Donohue & Associates. Each comment/concern from the agency is followed by a corresponding response from Geraghty & Miller, Inc.

#	page/paragraph	comment/response
	General	<p>C: G & M followed the appropriate validation guidelines used by EPA Region V and did a thorough review based on the data packages they had available. It is not clear whether actual data sheets were qualified with the codes listed in the technical memorandum, or data tables in the RI. The units for method blank and trip blank contamination were not listed in the tables; it appears that they are likely pp. The validation indicated that "significant" laboratory contaminants were present, but based on the levels reported, all were at or below the allowable 10X CRDL and are therefore not significant.</p> <p>R: Actual data sheets were not qualified due to time constraints.</p> <p>R: Method blank and trip blank VOA results are ppm.</p> <p>R: Laboratory contaminants were at levels between the IDL and CRDL, except for a few instances. These levels when multiplied by 10, resulted in most associated positive samples results to be invalidated or flagged as U.</p>
1	10	<p>C: The samples with unusable volatile organic results should be listed or noted in the RI data tables.</p> <p>R: The sample results qualified as unusable will be listed in the RI data tables. Deadlines on previous report prevented the tabulation of the data validation conclusions.</p>
2	13/Internal Standards Performance	<p>C: Were the reanalyses flagged as estimated based on the holding time exceedances? What samples and analytes were associated with the internal standards outliers?</p> <p>R: Sample data associated with quality assurance failures will be flagged.</p>
3	18/Matrix-Matrix Spike Duplicates	<p>C: The compound used for the MS should be 1,1-Dichloroethene, not 1 - Dichloroethane</p>

PAGE 9

USEPA HI-MILL DRAFT TECH MEMO COMMENTS
PART 2 - ANALYTICAL LABORATORY DATA VALIDATION SECTION

3 18/Matrix-Matrix Spike Duplicates (Continued)

R: This was a typographical error. Notes correctly indicate 1,1-Dichloroethene.

4 20/Holding Times

C: Was the holding time to extraction or to analysis exceeded and by what number of days? Were the protocol in the EPA March 16, 1990 Data Review Issues memorandum used to assess if a J code was assigned?

R: Holding times to extraction was exceeded on sample HMS-YX12-2. Time from sampling to extraction was 37 days. Judgement used to assess J flag based on semi-volatile sample results from all other sample points.

5 20/Calibration

C: Was a J code assigned to the affected sample data for these compounds? What samples were affected?

R: Due to report schedule constraints, a J flag was assigned but not entered on the tables of affected samples. A list of samples and compounds affected is on page 21.

6 26/Calibration

C: What criteria were used to assess if exceedances were "Severe" enough? The EPA data validation guidelines do not cite any criteria other than any percent RSD greater than 25 percent (CCV), 30 percent (ICV).

R: Based on judgement using the whole site data base, it was deemed that the quality assurance failures, though outside of limits, did not adversely affect the usability of the data for site decision-making processes. This data validation was approached to keep as much usable data as possible for making responsible decisions at this site.

7 33/Field Duplicates

C: What is a "good degree" of precision for field duplicates? Was there a DQO goal set in the QAPP and was it met?

PAGE 10

USEPA HI-MILL DRAFT TECH MEMO COMMENTS
PART 2 - ANALYTICAL LABORATORY DATA VALIDATION SECTION

7 33/Field Duplicates (Continued)

R: Most all of the field duplicate results were within validation guidelines limits (+/- 20%). The data quality objective was CLP level IV. The SOW indicates that field duplicate use for qualifying related data should be based on judgement of the data reviewer. It is felt by this reviewer that the intent of a field duplicate was satisfied on this job.

8 34/Holding Times

C: How severe were the holding time exceedances, and were the protocol in the March 16, 1990, EPA memorandum followed?

R: The holding time exceedance for cyanides were on a few samples, and were generally one to two days. With the QAPP specified holding time of 12 days, these were out of compliance. Due to these minor exceedances, it was not thought to be adversely affecting data quality, therefore no qualification of data was necessary. The EPA memorandum of March 16, 1990, was not in possession of this data validator at the time of this review.

AGENCY COMMENTS

**PART 3
PROPOSED MONITORING WELL SAMPLING ACTIVITIES SECTION
HI-MILL DRAFT TECHNICAL MEMORANDUM**

#	page/paragraph	comment/response
11	1/2	<p>C: SW-2 is not proposed for resampling but it is included in the list of monitoring wells proposed for resampling on page 3.</p> <p>R: Typographical error, monitoring well SW-2 has been removed from proposed sampling list.</p>

AGENCY COMMENTS

PART 4 ECOLOGIC INVENTORY/ASSESSMENT SECTION HI-MILL DRAFT TECHNICAL MEMORANDUM

Below are comments concerning the Ecologic Assessment Section of the Hi-Mill Manufacturing Draft Technical Memorandum from Donohue & Associates (#1-#7); Deborah Larson of the MDNR (#8); Douglas Beltman of the USEPA (#9). Each comment/concern is followed by a corresponding response from Geraghty & Miller, Inc.

#	page/paragraph	comment/response
1	1/2	<p>C: Geraghty & Miller point out that to establish a casual relationship between releases from hazardous waste sites and ecological effects, the presence, concentration, and variability of specific toxic chemicals must be established. In part 4, G & M does not propose to collect additional surficial or sediment samples for chemical analyses. While additional sampling may not be necessary, and we assume that G & M does not intend to collect additional samples, they should comment specifically on the adequacy of the available chemical analyses to meet DQOs.</p> <p>R: Data Quality Objectives (DQOs) will be discussed at the pre-QAPP meeting and included in the QAPP.</p>
2	2	<p>C: Recognition that the lack of soil and sediment quality criteria can be addressed by conducting bioassays is an excellent point (Techna concluded that because such criteria did not exist, it was unnecessary to address this issue)</p> <p>R: Agency is a strong advocate of bioassay sampling.</p>
3	3/2	<p>C: G & M should specify what organisms are going to be used in the bioassays.</p> <p>R: Determination of bioassay organisms will be discussed at the pre-QAPP meeting and included in the QAPP.</p>
4	3/3	<p>C: G & M should specify what the criteria are for concluding that the sediments do not result in toxic effects. Are the results of the bioassays going to be compared to controls, or are the bioassays using sediments from areas known to be contaminated going to be compared to the results of bioassays using the "clean" sediments from Target Pond?</p> <p>R: Criteria and controls of bioassay sampling will be discussed at the pre-QAPP meeting and included in the QAPP.</p>
5	4/2	<p>C: Characterization of potential faunal communities based on literature surveys of species distributions should be field-verified. This verification should include at least a walk-over of the site to verify the availability of appropriate habitats, if not consisting of an aerial faunal survey.</p> <p>R: Faunal community characterization procedures will be discussed at the pre-QAPP meeting and included in the QAPP.</p>

PAGE 13

USEPA HI-MILL TECH MEMO COMMENTS
PART 4 - ECOLOGICAL INVENTORY/ASSESSMENT SECTION

- 6 5/2 C: Regardless of the outcome of the bioassays, a benthic macroinvertebrate survey of Target Wetlands should be conducted to verify the high density of midges and low diversity of the benthic macroinvertebrate community reported by earlier studies.
- R: The options of conducting benthic macroinvertebrate survey will be discussed at the pre-QAPP meeting and included in the QAPP.
- 7 6 C: The work plan mentioned in this section should describe the exact methods proposed to conduct the field work (i.e., flora and fauna surveys).
- R: A work plan containing detailed sampling methodologies will be submitted prior to initiating any field work.
- 8 General C: MDNR supports the proposal for bioassays as part of the ecologic inventory/assessment for the wetland. However, MDNR feels that additional data is needed to properly assess the quality of the target wetland. I have attached a copy of a memo sent to me by Mr. Roger Jones in the Surface Water Quality Division of MDNR containing his opinions and recommendations for additional data collection needs to accurately assess the wetland quality. Briefly, Mr. Jones feels additional sediment samples are needed to determine contaminant concentrations at depth in the wetland; and he also recommends analyzing for several additional parameters. Further three metals- copper, nickel, and silver- are at concentrations in marsh water samples that exceed levels that are considered aquatic chronic values which protect aquatic organisms on a long-term basis. (Reference Rule 57 (2) of the MDNR Water Resources Commission General Rules pursuant to Act 245 of the Public Acts of 1929, as amended.)
- R: The advantages and disadvantages of collecting additional sediment samples will be discussed at the pre-QAPP meeting and included in the QAPP.
- 9 General C: The proposed workplan needs to be improved in several aspects. First, not enough detail is provided on methods. Second, work must be better coordinated between the three phases and put in the context of overall assessment objectives and purposes. Third, several important aspects of ecological assessments are not addressed in this workplan.
- R: Mr. Beltman's general and specific comments will be discussed in the pre-QAPP meeting and be addressed in the work plan documents.

AGENCY COMMENTS

PART 5 BASELINE RISK ASSESSMENT REVISIONS SECTION HI-MILL DRAFT TECHNICAL MEMORANDUM

Below are comments from Life Systems, Inc. and corresponding responses from Geraghty & Miller, Inc. concerning the Hi-Mill Manufacturing Draft Technical Memorandum:

#	page/paragraph	comment/response
1	General	<p>C: Only the part of the technical memorandum referring to risk assessment was received for review. In general, Geraghty & Miller appear to have addressed the inadequacies documented in our first review of the risk assessment (TR-1107-18). We have noted a number of items in the approach that appear inconsistent with EPA guidance. This was not an exhaustive review since that cannot be done without more information, not just equations proposed for us quantifying exposure.</p> <p>R: General comments by Life Systems required no response.</p>
2a	1	<p>C: In summarizing the validated data there should be explanations of detection limits, blank contaminations, etc., which are used in developing the set of contaminants of potential concerns. Chapter 5 of the RAGS lays out the groundwork for this.</p> <p>R: Description of sample analytical methodology, detection limits, and quality control samples and qualifiers is appropriately discussed in Chapters preceding the baseline risk assessment chapter. A reference to the previous chapter will aid the reader in locating the analytical and quality control information identified in Chapter 5 of RAGS.</p>
2b	1	<p>C: Exposure pathways identified for quantification appear reasonable with the following exceptions. Is there really a potential for fugitive dust emission? Isn't most of the site vegetated? Will both current and future land uses be quantified for surficial soils?</p> <p>R: Current and future land uses will be assessed. Current exposure will consider a trespasser and/or worker exposed to soils by dermal contact, incidental ingestion, and inhalation of fugitive dust or vapors on site. Future exposure will consider a hypothetical residential exposure via dermal contact, incidental ingestion, and inhalation of fugitive dust or vapors. Fugitive dust emissions are not considered a significant release mechanism because of the site vegetation. Off-site fugitive dust emissions will not be quantified. However, for on-site exposure it will be assumed that if dermal contact and incidental ingestion exposures are possible, then inhalation of fugitive dust at the exposure site is also possible.</p>

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- 2c Page 2 C: There are no current occupational populations?
- R: There are occupational populations on site, however, whether exposure of these populations is a OSHA jurisdictional issue and beyond the purview of CERCLA is an issue that does not currently have a definitive USEPA answer. If USEPA Region V policy requires the inclusion of occupational populations then workers will be included in the revised baseline risk assessment.
- 2d Page 2 C: The second sentence in the second bullet seems to neglect the concept of population risk. Risks are summed dependent on those pathways that affect a given population. What would a total site risk be?
- R: Total risk would be the summation of all pathways by which a hypothetical receptor population or individual could be exposed. This is the RME total site risk for the most sensitive receptor population.
- 2e Table 1 C: We recommend keeping the oral and dermal pathways equations separate. The dermal calculation gives an absorbed dose and therefore the toxicity value must be adjusted, in most cases, from an administered to an absorbed dose.
- R: Dermal exposure doses are adjusted for administered dose by incorporation of the bioavailability factor (BAF) in the equation.
- 2f Table 1 Equation 1
- C: ¹It is unclear what exposure frequencies will be assumed for residents and visitors (for all scenarios). Are they really the same for both ingestion and dermal contact?
- ²These calculations are done for three periods: subchronic, chronic and lifetime. This concept does not appear to be addressed in the exposure periods and subsequently the averaging periods in these equations. Lifetime is not calculated for a child population - only subchronic and chronic.
- ³Will a fraction ingested from the contaminated source be 100% (no term in equation for this)?
- ⁴The soil to skin adherence factor appears low. Please provide this reference.
- ⁵We assumed the bioavailability factor was equivalent to an absorption factor and accounts for the desorption of the chemical from the soil and across the skin barrier. Provide documentation of the values to be used.
- ⁶The term SMF is undefined in the equation.
- ⁷The EPA considers 70 years as lifetime exposure duration in order to be consistent with the lifetime in years assumed in slope factor determinations.

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R: ¹Exposure frequencies for the residential exposure will be 30 years for the adult (95 percent UCL residential period) and 6 years for the most sensitive child population (ages 0-6 when soil ingestion would be the highest). Exposure frequency for visitors will be 234 days (once a week, for 26 weeks [late spring to early fall] over a 9 year period [older children aged 10 to 18]). Exposure via dermal contact and incidental ingestion is assumed to occur concurrently.

²Chronic exposure periods are more conservative than subchronic exposure periods. Chronic toxicity values (RfDs) are often lower than (but never higher than) subchronic toxicity values. The exposure periods and exposure frequencies considered at the Hi-Mill Manufacturing site would all qualify as chronic exposures (greater than 10 percent of the lifetime [7 to 7.5 years for humans]). The more conservative chronic exposure scenarios will be assessed in the baseline risk assessment. Excess lifetime cancer risks are based on exposure averaged over a lifetime, therefore, chronic exposures are averaged over a lifetime for cancer risks.

³Fractions ingested from the contaminated source (95 percent UCL of concentrations detected in surficial soils) will be 100 percent. This is considered an RME scenario.

⁴The soil to skin adherence factor is based on adherence of soils and the effective thickness of soils that are in contact with skin (Massachusetts DEP, 1989; Hawley, 1985; McKone, 1990).

⁵Bioavailability factor is the ratio of reported dermal absorption rates to reported oral absorption rates. It is used to adjust the dermal exposure rates for comparison with the oral reference doses.

⁶The SMF is the soil matrix factor. this is an absorption factor that accounts for desorption of the chemical from soil and across the skin barrier (Hawley 1985).

⁷Lifetime in the USEPA Exposure Factors Handbook (USEPA, 1989) is identified as 75 years.

2g Table 1 Second equation

C: The terms representing emission of vapors and dispersion of vapors in air in the equation for exposure to vapors appear incomplete. All values for the terms should be presented with supporting narrative.

R: Supporting references will be included in the reference section of the revised RI report.

2h Table 1 C: The quantitation of the inhalation pathway by using an assumed total suspended particulates appears overly conservative. The value of 75 ug/m³ referenced here has been superseded. The level of the national primary and secondary standards for a particulate matter is 50 ug/m³ (52 FR 24663, July 1,

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1987). We have already questioned whether this pathway is even complete. What is the source of these particulates?

R: Source of the fugitive dust is the same surficial soil for which the dermal contact and incidental ingestion is being quantified. If fugitive dust exposure is impeded then dermal and oral exposure should also be impeded. The suggested fugitive dust concentration of 50 ug/m³ will be incorporated into the equation.

2i Table 1 HQ and CR equations

C: No adjustment for the extrapolation of oral toxicity values to the dermal route is mentioned.

R: The BAF factors in the equations are the adjustment factors for the dermal exposure route.

2j Table 2 C: Previous comments regarding averaging period and exposure period apply here also. No chronic or subchronic exposures are included. Children are excluded as an exposed population.

R: Chronic exposure is quantified because this is the hypothetical future RME exposure. If subchronic exposure scenarios were calculated they would result in lower risk values.

2k Table 3 C: A dermal absorption factor should not be included here. The permeability constant (WF) reflects movement across the skin into the bloodstream. Please document the water flux number. Has a conversion been made here? The units of a permeability constant are cm/hr. Previous comments regarding averaging periods (subchronic, chronic, lifetime) and the extrapolation to calculate dermal toxicity values are relevant here also.

R: If there are sufficient permeability constants, this approach will be substituted for the water flux that was listed for swimming exposure. Chronic exposure periods are considered more conservative than subchronic and will provide more protection of public health. The absorption factor should have been identified as BAF and this factor will adjust the dermal exposure route for inclusion in the HQ and CR equations.

2l Table 4 C: Comments made previously regarding soil exposure in Table 1, equation 1 apply here. The ingestion rate assumed appears overly conservative. What type of activity is assumed that would result in ingestion of this much soil? Do you think such a small child would be reasonably playing in these areas?

R: The exposure scenario was developed to be highly conservative. If these values are too conservative the exposure scenario can be modified to be more realistic.

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- 2m Table 5 C: Document that the surface water bodies are large enough to produce a consistent supply of edible sized fish. Otherwise, don't quantify this pathway.

The assumed fish ingestion rate is much lower than that recommended in RAGS. Interim guidance suggest 54 g/day. There is no fraction ingested term in this equation--is it assumed all fish consumed come from these bodies (not likely)? Units for Csw should be mg/L. No children are exposed via this pathway? Previous comments on averaging periods and exposure periods apply here.

R: If the results of the ecological inventory indicate that the presence of harvestable-sized fish in the surface water is unlikely then fish ingestion exposure will not be qualified.

The fish ingestion rate is the annual average rate listed in the RAGS. This value assumes 100 percent contribution from the site. If the higher rate of 54 g/day is used with an assumed contribution of 10 percent then the resulting fish ingestion rate would be 5.4 g/day which is lower than the 6.5 g/day that is suggested in the equation.

- 2n Table 6 C: The following discrepancies are noted in the toxicity values:

The following values are missing:

- ◆ Subchronic RfDs
- ◆ RfDs for copper, silver, methylene chloride, tetrachloroethene
- ◆ The oral RfD for methylene chloride is 0.06

The following values are incorrect:

- ◆ There are no inhalation RfDs for acetone, 1,2-dichloroethene or ethylbenzene. Where did the values on this table come from?
- ◆ The oral RfD for toluene is 0.2, the inhalation RfD is 2
- ◆ Is 1,1,1-trichloromethane really 1,1,1-trichloroethane? If so, values are correct.
- ◆ Footnote the trichloroethene inhalation slope factor to indicate it is based on an absorbed dose.

- 2n Table 6 C: We suspect some of these chemicals will not be selected as contaminants of potential concern. For instance, zinc and copper can frequently be eliminated based on nutritional essentiality. Acetone, methylene chloride, methyl ethyl ketone, toluene, and the phthalates may all be field or laboratory contamination.

R: Exposure scenarios were assumed to be chronic exposures, however, the subchronic RfDs that are available can be added to Table 6

The following changes will be made to Table 6:

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- ♦ copper oral RfD of 0.037 mg/kg/day;
- ♦ silver oral RfD of 0.003 mg/kg/day;
- ♦ methylene chloride oral RfD of 0.06 mg/kg/day;
- ♦ methylene chloride inhalation RfD of 3 mg/kg/day;
- ♦ tetrachloroethene oral RfD of 0.01 mg/kg/day;
- ♦ toluene oral RfD of 0.3 mg/kg/day; and
- ♦ toluene inhalation RfD of 2 mg/kg/day.

Inhalation RfDs for acetone, 1,2-dichloroethene, and ethylbenzene will be eliminated from the table. The typographical error of 1,1,1-trichloromethane will be changed to 1,1,1-trichloroethane. A footnote will be added to the table to indicate that the trichloroethene cancer slope factor is based on a metabolized dose.

Identification of selected constituents of concern will be made after all the data that will be collected as part of the RI has been validated. If zinc and copper are not detected at concentrations above background and common organic laboratory contaminants are not detected at concentrations 10 times greater than concentrations detected in blank samples then they will be excluded from the final selection of constituents of potential concern.

August 30, 1991

Ms. Karla L. Johnson
Remedial Project Manager
USEPA, Region 5
230 South Dearborn St., 5HS-11
Chicago, IL 60604

RE: Final Technical Memorandum for Hi-Mill Manufacturing Company RI/FS

Dear Ms. Johnson:

Per your request of August 20, 1991, please find the copy of the final Technical Memorandum for the Hi-Mill Manufacturing Company RI/FS (Technical Memorandum) for your files.

This document contains the changes in Table 4B requested by the Environmental Protection Agency (EPA) in your correspondence dated June 3, 1991. The June 3, 1991, correspondence also requested the date on the Technical Memorandum be changed to "June 1991" which reflects the month in which the EPA gave its final approval.

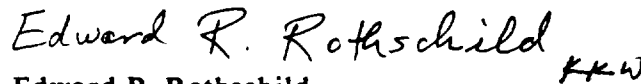
Please call us if you have any questions regarding this document.

Sincerely,

GERAGHTY & MILLER, INC.



Kevin K. Wolka, P.E., Ph.D.
Project Coordinator
Principal Engineer/Manager, Ground-Water Services



Edward R. Rothschild
Regional Vice President

cc: Deborah Larsen, MDNR
Robert Davis, Butzel Long Gust Klein & Van Zile
Robert and Richard Beard, Hi-Mill Manufacturing Company